

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XXXVI.

March 20, 1937

No. 925

A Promising New Technique

A PAPER of remarkable interest was read by Professor F. Paneth on "Natural and Artificial Radio-elements and their Practical Applications in Chemical and Biological Research" at the March meeting of the London section of the Society of Chemical Industry. Only in selected instances is the second place of decimals per cent. of real significance in ordinary methods of macro-analysis, though, of course, there are occasions when a constituent is present in minute amount, and special methods are available, in which even the fourth place of decimals may be stated with some degree of certainty. Most analysts for most processes would probably agree that 10^{-4} grams is the limit of sensitivity. In micro-chemistry the limit falls to 10^{-8} grams. Professor Paneth gave the limits of spectroscopic analysis as 10^{-8} or 10^{-9} grams. But for radio-active methods, the limit becomes of the order of 10^{-17} grams. That is, in itself, a very remarkable achievement, and it has the beauty that comparatively little is required in the way of apparatus or technique.

Instances were given during the discussion in which those using the method had made the apparatus themselves; judging from Professor Paneth's remarks all that is required is (1) a method of producing artificial radio-active elements, and (2) a simple form of measuring electroscope in which the rate of closing of the charged gold leaves can be measured in terms of divisions per unit time. If the radio-active element be evolving α -rays, the metal support of the electroscope leaf is placed directly over the radio-active substances; if the β -rays are to be measured, the α -rays are screened out by a thin metal plate. The method depends upon the fact that the isotopes of many elements can be produced by induced radio-active methods, and are themselves radio-active. It has long been known that thorium C is equivalent to bismuth, and that thorium B is the isotope of lead. If an isotope and its normal element are mixed and subjected to chemical operations, then if the result of the operation is to isolate x per cent. of the normal element, it also isolates x per cent. of the added radio-active element. Consequently, by determining the amount of radioactive element present, by the electroscope, it is possible to use that figure as the measure of the weight of the normal element present. This method can, for example, be used to measure the solubility of lead chromate.

Another important feature of this new technique is that actual exchange of atoms can be studied, and in this way the physical fact of electrolytic dissociation has been proved. Let, for example, lead chloride and lead nitrate be dissolved in water, one of these sub-

stances only containing a trace of radio-active lead; and let the solution be evaporated so that lead chloride is precipitated on cooling. If there is no electrolytic dissociation in solution, the radio-active lead will be found only in one of the salts, but if the molecules are dissociated, the radio-active lead will be uniformly distributed between the two salts when one has crystallised from the solution. Experiment shows that the radio-active lead is distributed and therefore the molecules have been dissociated.

These methods could not be generally adopted except for a few elements up to some two or three years ago, but then the artificial radio-elements were discovered and radio-active analysis can now be applied to many elements, of which Professor Paneth particularly mentioned phosphorus, sodium, nitrogen and calcium which are of value in physiological and biological studies. Activation is effected merely by bringing the element near a neutron source. It is important to observe that this operation must usually be conducted under water or paraffin in order to slow down the speed of the neutrons by collision to permit them to be caught and retained by the element being activated. An essential difficulty in the procedure is that the radio-elements are subject to decay according to the exponential law. Rhodium, for example, decays to half activity in 44 seconds, and silver in 3 minutes. For the methods to be of value over lengthy periods it is necessary for elements with longer half-periods to be discovered.

The study of the exchange of atoms between molecules was impossible before the discovery of isotopes. It is now possible, for example, to study the self-diffusion of lead into itself in molten lead, and if radium-D (half-period 12 years) be used the self-diffusion of solid lead can be made apparent after two years. It has been shown by studying multivalent elements that the valency is not rigorously attached to one atom, but is constantly being exchanged between atoms; this has been shown by causing one salt of the element to become radio-active and mixing it with other compounds that are not radio-active, but in which the element under investigation has valencies different from the radio-active salt. It has been found possible to determine the extent of the surface of crystalline powders by induced radio-active methods. In the biological field the distribution of phosphorus between the bowels, kidneys and bones has been ascertained by using feeding stuffs containing active phosphorus; and physiologically it has been found that atom-exchange in plants causes new leaves to be formed from the materials of old ones. A very promising new technique!

Notes and Comments

A Vital Industry

THE most welcome fact which emerged from the debate on the Caledonian Power Bill which was rejected in the House of Commons last week was that the Government had resolved that the enormously important calcium carbide industry must be established in this country. National rather than nationalistic interests governed the opposition of the Welsh Members to the private Bill which sought to establish the industry in the Highlands, and a strong case was made out for the location of the industry in South Wales. It was stated in support of the Scottish scheme that the Highlands offered the best site for a hydro-electric plant of the type employed in Norway, but against that it was urged that a carbide factory could operate on an equally economic basis generating its own electric power by means of plant using South Wales "duff" coal. Any advantage in the cost of electricity in Scotland would probably be counterbalanced by the cost of transporting the raw materials and distributing the finished product. The new industry would find a natural home in South Wales, since anthracite and limestone exist in abundance, and the scheme would find work for miners and others on the spot, not only in mining the coal for manufacturing carbide, but in generating the electric power required.

Urgent Need for Carbide

B RITISH industry is in urgent need of calcium carbide, for Great Britain is in the unsatisfactory position of being the only great industrial nation without its own calcium carbide industry. Every form of welding operation requires acetylene, for which carbide is the basis, and heavy industry as a whole is dependent upon abundant supplies of this product. Carbide is also the basis of calcium cyanamide, an artificial fertiliser in increasing demand. Last year 55,600 tons of carbide were imported into this country at a cost of £613,000. In the first two months of the present year imports have amounted to some 8,643 tons in weight and £97,279 in value, against 7,876 tons (£88,402) in the corresponding period of 1936. In Germany, Italy, France and Japan the erection of carbide factories is considered an essential measure of defence. It is estimated that a calcium carbide factory producing 50,000 tons a year would give direct employment to about 2,000 men, and indirect employment to many more in the anthracite, limestone and coal mining industry. That the Government is alive to the importance of the industry is indicated by the fact that in the House of Commons on Wednesday night, Sir Thomas Inskip, Minister for the Co-ordination of Defence, answering Mr. Petherick, said that he had taken steps, in consultation with other Ministers concerned, to set up a small committee composed of persons not in the Government service to advise the Government how best the country might be provided with a supply of calcium carbide and applied products.

Scotland's Empire Exhibition

S COTLAND is arranging an Empire Exhibition, to be held just outside Glasgow from May to October of next year, which promises to be the biggest show since the British Empire Exhibition at Wembley in

1924-25. Its principal objects are to illustrate the progress of the Empire at home and overseas, to show the resources and potentialities of the United Kingdom and Empire overseas to the new generation, and to stimulate Scottish work and production. The directors of Imperial Chemical Industries, Ltd., have shown what they think of the venture by contributing £10,000 to the guarantee fund, and other contributors to date include G. and J. Weir, Ltd. (£10,000), British Oxygen Co., Ltd. (£5,000), Scottish Oils, Ltd. (£3,000), North British Distillery Co., Ltd. (£2,500), Fairy Dyes, Ltd. (£1,000) and Chance Brothers and Co., Ltd. (£750). Up to the present the chemical industry has taken no steps to be represented in an organised way at the exhibition; bearing Wembley in mind it is scarcely likely that it will do so. We imagine, however, that those who have supported the scheme financially will exhibit, together with a number of other individual firms which deem it to be to their advantage to show the public what they are capable of producing.

Overseas Trade Expansion

T WELVE months ago we recorded that for the first two months of 1936 our exports of chemicals, drugs, dyes and colours had decreased by £148,867 compared with the same period of 1935, while imports had increased by £146,839. A marked improvement has been registered this year, exports for January and February having risen by £459,199 (and by £310,332 over the same period of 1935) while imports are £160,426 higher than a year ago. A satisfactory feature of the export figures is that the increase is more or less evenly distributed over 25 of the 35 purchasing countries enumerated in the Board of Trade returns, and is not, therefore attributable to any spasmodic circumstance unlikely to recur. Both Germany and the United States purchased more British products during the two months, thus offsetting to some extent the continued increase in imports from those countries. Of the total increase in imports no less than £70,728 represents increased purchases from British countries. Germany and the United States are reported to have recorded a combined increase of £68,498, but against this has to be set a rise of £79,526 in exports, giving Great Britain a favourable balance for the two months which she has not enjoyed for some time past. Taking the figures as a whole it is clear that 1937 has opened in a much more satisfactory fashion for the chemical industry, quite apart from the abnormal demands that are likely to be made upon it in connection with defence.

Coronation Seats Banned

D ISAPPOINTMENT has befallen many members of the Chemical Society who had hoped to share with members of six other societies having headquarters at Burlington House, some 900 seats to view the Coronation procession, were to be let to members at 50s. each, with luncheon. To make the scaffolding secure it would be necessary to insert tubular steel girders through the windows of the building, which would have had to be kept open for the whole of the period. Office of Works officials refused to sanction this arrangement, and the London County Council banned the scheme as unsafe.

Copper in Chemical Engineering

An Ideal Metal for Plant Fabrication

THE possibilities of copper as a material for the construction of chemical plant were discussed by Dr. Stanley Baker, Ph.D., M.Sc., A.I.C., in a paper read at a meeting of the Chemical Engineering Group, in London, on March 12, when the chairman of the Group, Mr. Stanley Robson, presided.

The copper used for chemical construction work is almost always supplied in wrought forms such as plates, sheets, strip, tubes, sections and rods. The distinction between plates, sheets, strip and foil is one of dimensions. Copper in flat condition $\frac{1}{8}$ in. or over in thickness, is termed "plate." If the thickness lies between $\frac{1}{16}$ in. and 0.01 in. with a width exceeding 15 in. it is termed sheet; lengths and widths may exceed 12 ft. and 4 ft. respectively. Strip is generally supplied in coils and the usual thickness lies between 0.06 and 0.007 in. with widths up to 24 in., though they may reach 36 in. For thicknesses less than 0.006 in. the term "foil" is used.

Determination of Hardness

These forms of copper are supplied either hot or cold rolled, the latter condition being produced by making the final reductions in thickness in the cold from the previously hot rolled material. In general, cold-rolled sheets have a smooth bright finish, and the hot-rolled a matte surface. The amount of reduction in thickness by cold working almost entirely determines the hardness of the material, which can therefore be controlled within narrow limits. Sheets for chemical plant construction are usually used in the hot-rolled or annealed condition, as they have to undergo various shaping operations.

The skill of the coppersmith lies in his ability to work the copper to the desired shape without unduly thinning or thickening it in any part, except as required by the design. The principal methods employed for making seams in sheets are autogenous welding, brazing, bronze welding, silver soldering, soldering and riveting. Autogenous welding is invariably used for joints which will come into contact with corrosive liquids, as the absence of any second metal, and the fact that the seam can be hammered so as to be identical in all respects with the parent metal, eliminates preferential corrosion of the seam. Brazing is widely used for seams where very high corrosion resistance is not required; the brazing metal consists of a copper-zinc alloy of melting point about 850°C . with a copper content varying between 50 per cent. and 60 per cent. Bronze welding forms a strong joint which has good corrosion resistance. In bronze welding the copper itself is not melted and therefore the work does not require such intense heating as autogenously welded work. It is therefore useful for parts of the plant which are somewhat inaccessible, or which cannot be hammered after welding. Until the development of autogenous welding, riveting was widely used for joining sheets; nowadays its use has declined, though it is still used for thick copper sheets over about $\frac{1}{8}$ in. and for assembling plant on site where welding is not practicable.

Corrosion Resistance with Increased Strength

Though copper possesses adequate strength for most plant construction a metal is frequently required which combines the high corrosion resistance of copper with increased strength. For this purpose numerous alloys of copper have been developed which can be used in conjunction with copper without danger of electrolytic corrosion owing to the predominance of copper in their composition. The elements most commonly added are zinc, tin, nickel and aluminium, while such elements as silicon, manganese, iron, lead and beryllium are used in smaller quantities, either alone or, more commonly, in conjunction with larger additions of other alloying elements. The most important of the copper alloys from the engineering point of view are the copper-zinc alloys, or

brasses, although for chemical engineering work they are not as important as for general work owing to the limited corrosion resistance when compared with other alloys of copper which can be obtained with similar mechanical properties.

One of the most important applications of copper is in the construction of various forms of heat interchange plant. The use of copper for such purposes is attributable to its high rate of heat transfer, its excellent corrosion resistance, and its ease of manufacture.

Evaporating apparatus may be of the jacketed or tubular type, the former being exemplified by jam boiling pans, for which copper is almost exclusively used, and the latter by the more widely adopted vertical or horizontal evaporators, in which the heating element is a nest of tubes through which steam is passed. Copper, brass and bronze tubes are extensively used for this purpose even where the rest of the plant is made of other material, owing to the high rate of heat transfer which is attainable. This is due to the smooth nature of the tubes, the cleaner surface owing to the absence of corrosion products, and also to the fact that thinner walled tubes can be used than would be the case with iron, steel or lead. Hausbrand assesses the efficiency of copper tubes in the evaporation of water and salt solutions of medium concentrations, as about 25 per cent. better than iron and 50 per cent. better than lead.

When tubes of copper or its alloys are used, the tube plates are also generally made of these materials. The tubes are expanded into the plates, and owing to the similarity of the thermal expansions of all these materials, the possibilities of leaks due to changing temperatures are avoided. When the liquor being evaporated is corrosive, the shell and separator, as well as the tubes and tubeplates, are also made of copper, which may in some cases be tinned.

Uses of Copper and Copper Alloys

Industries using copper or copper alloy tubes and tube plates, include the following: Sugar, salt, glucose, glue, magnesium sulphate, iron sulphate, sodium sulphate, sodium nitrate, zinc chloride, water. Industries using copper and its alloys for the whole evaporator include: Sugar, milk, malt extract, coffee extract, tannin extract, gelatin, lactic acid, ammonium sulphate.

Copper stills may either be fire-heated as in the case of spirit and essential oil stills, or they may be heated by steam (either open or closed), which is a more economical method when the temperature required is not too high, and it also enables accurate temperature control to be exercised. Steam distillation is used very largely for various organic substances such as alcohols, esters and other solvents and oils.

Copper condensers of the tubular or coiled types are usually employed when the still is copper. They may consist of one tube or may contain up to several hundred tubes, expanded into copper or brass tube plates. Heat exchangers are common in almost all chemical industries and are of very varied types. Copper and its alloys are largely used for these units on account of their high rate of heat transfer and corrosion resistance. They may consist of lengths of copper tubes, as in attemperators for breweries, of copper coils, of a number of tubes expanded into a tube plate, or of the plate pattern, where the two liquids are separated by thin sheets of copper whilst the fluted construction of the cast bronze frames against which the copper sheets fit flush, causes the liquids to change the direction of flow several times at each plate, thus ensuring rapid heat transfer.

Copper coils are used for the condensers in marine refrigerators, which employ carbon dioxide as a refrigerant, in order to resist the corrosion of the sea water which has to be used for cooling purposes. Copper tubes are also used for refrigerating machines which employ organic refrigerants.

Water Supplies and River Pollution

Annual Report of the Water Pollution Research Board

IN the annual report of the Water Pollution Research Board for the year ended June 30, 1936, it is emphasised that unless satisfactory methods of treatment and disposal of sewage and industrial effluents are more widely adopted there will be considerable difficulty in providing the large volumes of water of good quality necessary for domestic, agricultural and industrial purposes.

On the one hand, the demand for water of the highest chemical and bacteriological quality is increasing. This increase is due partly to improved conditions of housing with more general provision of public water supplies, baths, modern sanitary appliances, and hot water and central heating systems. It is also due partly to the development of modern factories in which large quantities of clean water are used in the manufacture and preparation of beverages, foods and other products under more hygienic conditions. On the other hand, recent improvement in the trade of some of the older industries, the introduction of new processes and industries and the development towards centralisation in certain industries, particularly those dealing with agricultural products, have caused increases in the quantities of polluting effluents discharged into rivers in many parts of the country. Difficulties which could have been avoided have arisen in some instances owing to the fact that, in selecting sites and planning factories, adequate consideration was not given to the quantity and quality of the water required for the processes nor to the problems of disposal of the waste waters.

The investigations in progress under the Board deal with certain aspects of water supply with methods of treatment and disposal of sewage and trade waste waters, and with problems of river pollution.

Water Softening Materials

Experiments have been continued on the preparation and properties of material suitable for softening water by the base-exchange process. This process is the basis of the water softeners in use in many households; it is also employed on a large scale by several water supply undertakings. Base-exchange materials on the market include treated minerals and synthetic zeolites manufactured chemically. Though some of the synthetic products are made in this country the minerals are all imported. The investigation has shown that satisfactory water softening materials can be prepared from certain British clays. The material prepared from British fullers earth is in fact superior to the imported treated clays. Several firms are now considering the commercial possibilities of utilising treated fullers earth for water softening.

Resins Remove Salts

Earlier work under the Board had led to the discovery that synthetic resins prepared from certain phenolic substances and tannins possess marked base-exchange properties and can soften comparatively large quantities of hard water. Unlike synthetic zeolites and treated clays now in commercial use, many of these resins are not detrimentally affected by solutions of acids and alkalis. It had also been discovered that resins possessing acid-exchange properties can be prepared from certain aromatic bases. By treating natural waters first with a base-exchange resin, and then with an acid-exchange resin the salts in solution can be wholly removed. These important discoveries have opened a new field of investigation and experiments on the properties of many examples of the resins have been continued. The investigation has roused widespread interest and has led to numerous inquiries from all parts of the world. Several commercial firms are now actively interested. Some of the firms are already manufacturing the resins in small quantities.

The method previously devised, as a result of the Board's work, for determining the true average concentration of lead

in the drinking water withdrawn from a household service over a period of several weeks has been improved. In its improved form it has been tried on household services in several towns. According to this method the water passes through a meter and then through a filter, containing magnesia and chalk, which takes up the whole of the lead from the water. The quantity of lead taken up by the filter can readily be determined by analysis.

Milk Factory Effluents

An outstanding advance has been made in the Board's investigation of methods of purification of waste waters from dairies and milk products factories. Disposal of waste waters from the milk industry without causing serious pollution of rivers and streams or difficulties at sewage disposal works is a problem of great urgency at many dairies and factories. The importance of finding practicable methods of solving the problem is appreciated by the industry.

Through the Milk Marketing Board the industry is co-operating in the work and during the past year contributed £3,300 towards the cost. The experiments already carried out in the laboratory and particularly on a large scale at a factory have demonstrated that it is practicable to purify milk washings, such as those from milk collecting and distributing depots, creameries and condensed milk factories, by the activated sludge process or by biological oxidation in percolating filters operated under certain conditions. Several factories have already installed or are installing purification plants designed on the basis of the information obtained in the investigation. In addition to showing how the waste waters can be purified, the investigation has drawn attention to unnecessary losses of milk, cream, buttermilk, skim milk and whey in the wastes.

Sewage Disposal

The report includes a summary of the principal results obtained during the past few years in an investigation of the biology and biochemistry of the activated sludge process of purification of sewage. It also includes the results of recent experiments on physical and chemical aspects of sewage purification.

The investigation of the River Mersey which is being carried out with the object of determining the effect of the discharge of crude sewage on the nature and amount of the solid matter deposited in the estuary has been continued.

Fused Quartz and Silica Ware

THE latest (1937) edition of "About Vitreosil" (pp. 40), issued by The Thermal Syndicate, Ltd., shows the progress which has been made in the production of pure fused quartz and silica ware and its application to the chemical, electrical and other manufacturing industries. This book is well illustrated and contains much useful information upon such matters as the composition of packings and cements which can be used in conjunction with Vitreosil, chemical resistance with reference to particular metals and salts, and analytical operations for which laboratory apparatus can be employed satisfactorily (e.g. in the case of iron and aluminium phosphates, Vitreosil is definitely suitable for use in burning the precipitates and fusing the residue with potassium bisulphate). Extended numerical data in respect of electrical, mechanical, optical, and thermal properties is given to serve as a guide to the selection of Vitreosil for apparatus required in special researches. There is also a very useful bibliography of over 200 references to scientific papers dealing with the properties and industrial applications of fused silica ware.

Research for the Printing and Allied Trades

New Laboratories Opened in London

NEW laboratories, equipped with a wide range of modern equipment, for the use of the Printing and Allied Trades Research Association, were opened in Robin Hood Court, Shoe Lane, London, E.C.4, on March 9. The Duke of Gloucester officiated, and was received by Dr. G. L. Riddell, director of research.

In the new laboratories the P.A.T.R.A. is well equipped to carry out the principal phases of its work. The results of research into the basic problems of the industry, initiated by the Association under the guidance of its councils and technical committees, will be at the disposal of all members of the Association, and will be aimed at improving methods effecting economy in work, solving problems that concern the industry, and seeking and testing better materials and processes. In another direction the Association will investigate the problems which come to members in the course of their daily work; this service of the Association enables its members to have at their disposal a research and chemistry department and equipment covering every aspect of the industry. Finally, there is the information bureau which will answer questions where laboratory research is not required; it is provided with a full cross index system, exhaustive files, technical books and pamphlets.

On the occasion of the opening ceremony, an exhibition was



General View of the Chemical Research Laboratory.

A number of the processes and raw materials of the printing and allied trades are affected by changes in temperature and moisture content of the air, and it is essential to be able to carry out tests under controlled conditions. In the constant humidity laboratory the temperature is maintained at 65° F. and the relative humidity at 65 per cent. under conditions which do not deviate from these values by more than 1° F. and 1 per cent. R.H.

In this laboratory temperature is controlled by a bimetallic strip and a relay which causes the air to be drawn over heating lamps when the room temperature begins to fall. The moisture content is controlled by means of the slight change



A corner of the Humidity Chamber, showing paper testing apparatus.

arranged to show the application of research methods and instruments to the solution of the difficulties experienced with both processes and raw materials in the printing and allied trades. In the preparation of this exhibition considerable assistance was given by member firms, other research associations, scientific instrument makers and machinery manufacturers.

Two strong rooms in the basement, which were in existence when the building was taken over, have been converted into an optics laboratory (with the necessary apparatus for testing and measuring colour, opacity and other factors in printed matter and printing materials) and a constant humidity laboratory.

of tension produced in a bunch of human hairs when the moisture content of the surrounding air changes. When the atmosphere is too moist the hairs expand and operate relays which cause the air to be drawn over trays containing a drying agent. Similarly, when too dry, the hairs contract and cause the air to be drawn over wetting trays.

Here the printability of paper can be tested and the results of the tests will enable printers to decide with complete certainty the correct ink for each type of paper. The drying rate of inks, photogravure etching, preparation of plates for photolitho work, and suitability of papers for various printing processes will also be tested in this room.

Special instruments are installed for the purpose of finding

the bursting strength of paper, tearing resistance, endurance of being folded, tensile strength, elasticity and breaking stretch. The smoothness of paper is measured by taking the time for a given volume of air to flow between the paper surface and a smooth glass plate into a vacuum chamber. Porosity is measured by taking the time for a given volume of air to flow through the paper. A comparison of the abrasive quality of paper can be obtained with apparatus in which a strip of the paper is held in contact with a glass plate by a definite load and the strip pulled over the glass surface, the nature and number of the scratches produced on the glass (when viewed microscopically) being a criterion of the abrasive quality of the paper; this test is important for photogravure papers. The time required for an oil drop to penetrate through paper is a measure of the rate at which the paper absorbs oil; this is directly connected with ink drying problems, particularly in the case of news inks where drying primarily takes place by absorption of the medium. The rate of spread of an oil drop on the paper surface gives a measure of the oil-wettability of the paper, and it gives some indication of the printing properties of the paper.

Physics Laboratory

The first floor of the building has been converted into a physics laboratory for investigations on paper, bookbinding, colour fading, etc. Here is a photo-micrographic room, a dark room for general photographic work, and a dark room for work involving the use of ultra-violet light. A small scale printing machine, ink mill, and a blocking press are also housed in this department.

A photo-electric colorimeter measures the colour of an



Equipment for controlling humidity in the Humidity Chamber.

opaque or transparent specimen by plotting curves of percentage reflection or absorption against the wave length. In the case of an opaque object such as a printed surface the ratio of the light reflected to that reflected from a pure white surface is measured by means of a photo-cell. Six or more standard colour filters are used and the ratio determined in each case. Each determination gives a point from which the spectral reflection curve can be plotted. Fugitometer equipment enables papers, prints and bookcloths to be tested for fading at an accelerated rate under radiation approximating to sunlight, and under controlled temperature and humidity conditions.

Several routine tests are used for assessing the quality of adhesives. The gel strength of glue, for instance, is a criterion of its quality. In the gelometer the rigidity of the gel is measured by allowing lead shot to fall into a pan which presses a plunger into the jelly. When the plunger has sunk to a depth of 4 mm. the supply of lead shot is automatically cut off and the weight of the shot is determined; this weight is a measure of the gel strength. The viscosity of

glues is measured by means of the torsion viscometer. Here a cylinder suspended from a twisted wire is allowed to rotate in a bath containing the glue, and the decrease in swing of the cylinder gives the viscosity.

The usefulness of ultra-violet light as an aid to the study of inks and paper is shown by (1) colour difference between bleached and unbleached wood pulp, (2) "strike-through," (3) colour differences of dry ink pigments which appear to have the same colour when viewed in ordinary light, and (4) measurement of the water penetration time of papers using fluorescent powder.

Routine Analytical Work

The chemical analytical laboratory on the top floor is a true "service" laboratory where the analytical work entailed in major research problems and day-to-day problems sent in by member firms will be carried out. The amount of loading in a paper affects such properties as opacity, durability, handle, etc., and is determined by burning the paper in a muffle furnace at 800° C. The equilibrium moisture content of paper varies with the relative humidity of the atmosphere with which it is in contact; this moisture content is determined by drying in a hot air oven at 105° C. Reducing gases in paper—mainly sulphur dioxide and hydrogen sulphide—are determined by distillation into iodine solution, because their presence may cause the discolouration of ink. The presence of rosin sizing in papers may have an adverse effect on their permanence which is important for record papers. The "yellowing" of paper, for instance, can often be traced to a rosin content of 1 per cent. to 2 per cent. The rate of absorption of water or ink is a measure of the quality of blotting papers; it also indicates the liability of book papers to cockle when the edges are coloured.

Electrometric titration apparatus is used for titrations involving determination of several constituents in one solution. For example, the concentrations of both sulphuric acid and copper sulphate in an electrotyping solution can be determined in one titration by this apparatus, which may also be used for determining acidity or alkalinity of dark coloured solutions, such as extracts from straw-boards, coloured papers, etc.

The chemical research aspect of the Association's organisation is carried out in another laboratory on the top floor. These researches concern printing inks, photogravure, lithography, stereotyping and electrotyping. The pH of bichromated colloids (glue, gelatin, and albumen used in the photo-mechanical processes) affects the exposures necessary. This pH is measured by means of a recording pH meter, using a glass electrode and a calomel half-cell dipping into the bichromated colloid solution. To give another example, some printing inks have the property of setting to a gel if allowed to stand for a short time, but on shaking or stirring they become liquid and revert to a gel again on standing. It is probable that the initial setting of inks is due in part to this so-called phenomenon of thixotropy and that this is an important factor in the control of "set-off." The covering power of black printing inks, i.e., the number of square metres of a given paper which can be covered to a standard degree of blackness by one gram of ink, is measured with a photometer. To determine the drying time of printing inks the printed sheet is placed in contact with a plain strip and a weighted cog wheel is brought to bear on the proof sheet so that set-off is caused on the unprinted sheet; the two sheets are then drawn forward under the cog wheel and at the point at which set-off ceases the ink is considered to be dry.

Electrotyping and Lithography

In investigations concerning electrotyping and stereotyping, the thickness of the electro-deposit at any desired point on the plate is determined by measuring the time required to perforate the coating by an appropriate solution, which is allowed to impinge on the surface at constant pressure. This test is applicable to nickel, copper, bronze, zinc, and cadmium electro-deposits.

The relation between fatty acid and gum arabic on the litho plate is also an important item of investigation. The maintenance of the lithographic image and its transfer to paper, without scumming, is dependent upon maintaining a sharp surface of separation between the ink and the "watery" parts of the plate; this depends upon the angle of contact between the two constituents and the plate. A convenient method for measuring the contact angles, and then calculating the adhesion tensions, is adopted.

Adjacent to the chemical laboratories there is a balance room and a smaller room where relative humidity and temperature are under control so that varying climatic conditions can be rapidly reproduced for testing paper, ink, adhesives and the like and apparatus for measuring the acidity of various printing materials.

On the roof of the building there is an exposure frame where printed matter can be exposed to the weather and to light under every-day conditions and its reaction tested. This is especially useful for the testing of printed matter in the form of posters for hoardings and shop windows.

A small but well equipped workshop is provided in the basement where certain apparatus needed by members of the staff in their work may be made on the spot. Not only does this enable them to obtain apparatus specially suited to their

particular needs, but it has already resulted in a saving of money compared with cost of such apparatus purchased outside.

Until recently the Printing and Allied Trades Research Association had an income of only £1,500 per year, and did not seek the help of the Department of Scientific and Industrial Research in its work, which mainly consisted of providing an efficient information service to the industries served. The announcement, however, that the department was prepared to make increased grants to research associations, if corresponding increases in industrial support were forthcoming, led the printing and allied trades to reconsider their whole attitude to co-operative research. As a result industrial support for the association amounting to £7,000 per year was secured, and the D.S.I.R. agreed to add £3,000 per year to this figure so that the association has now an assured income of at least £10,000 per year. Membership, now exceeding 700 firms, includes printers, newspaper proprietors, paper makers, ink makers, engravers, book binders and allied trades. The reconstruction and expansion of the association means that its research activities are just beginning, and to this extent the association can be regarded as the youngest of the family of 20 co-operative research associations flourishing under the aegis of the D.S.I.R.

The X-Ray Interpretation of Protein Structure

Dr. W. T. Astbury Delivers the 37th Bedson Lecture

THE Bedson Club held its 37th lecture on March 5, at Armstrong College, Newcastle-on-Tyne, when Dr. W. T. Astbury, M.A., Sc.D., F.Inst.P., lecturer in textile physics in the University of Leeds, gave an account of his work on "X-Ray Interpretation of Protein Structure." Professor G. R. Clems took the chair.

Proteins, said Dr. Astbury, can be divided into two classes, fibrous and globular, and they all contain α -amino acids condensed, primarily, as polypeptide chains. This classical theory of Emil Fischer does not fully characterise the proteins and research has shown that these long polypeptide chains are folded and further cross-linked by the reactive centres of the side chains. In dealing with the proteins it is necessary to ask three questions:—what are the side chains, how are they distributed, and what is their stereochemical aspect? It was with the latter topic that the lecturer dealt in his talk.

The fibrous proteins are mainly stable, the simplest being fibroin (silk protein) which consists largely of glycine and alanine residues. Its X-ray photograph agrees with the view of a fully extended polypeptide chain, and this is confirmed by the fact that silk fibres cannot be reversibly stretched. Any stretching that does occur is permanent and due to the crystallites sliding over one another. The stretching of wool, hair, etc., is about 100 per cent. and reversible, and the usual X-ray photograph is not the same as that of fibroin; but on stretching a similar photograph has been obtained, indicating that keratin (the protein of hair) is a fully-extended polypeptide chain system only in the stretched state (β -keratin—the unstretched condition is known as α -keratin). It seems, therefore, that in the β -keratin form the proteins consist of parallel polypeptide chains linked by cross linkings, while in the normal or α -form these chains are folded. If keratin is stretched and steam applied the cross-links are hydrolysed and the extension then becomes permanent by the formation of new cross links. Keratin fibres can also be contracted by nearly 50 per cent. (supercontraction) due to further folding of the main-chain. This supercontraction of hair has been found to be very similar to the contraction of muscle. The extension and contraction of many fibrous proteins can take place by free rotation round the single valency links and

therefore unreasonable straining of the valency bonds does not occur.

The globular proteins are only stable within narrow limits. Some of them have been obtained in a crystalline state and in this condition X-ray investigation has been possible. Svedberg, by means of the ultracentrifuge, has indicated that the molecular weight is a simple multiple of 35,000 (approx.). The characteristics of this class are rapidly lost on denaturation and the stretched state of the denatured protein gives X-ray photographs very like those of β -keratin and the stretched fibres in general, thus showing that all proteins, whatever they are in the natural state, can be brought to a condition approximating to long polypeptide chains with cross links. The folding of these chains must be specific.

In conclusion, Dr. Astbury dealt with the feather protein and the virus which causes "mosaic" disease in tobacco plants.

Chemical Notes from South Africa

Alkali Manufacture

A PROFIT of £3,360 for the year ended June 30, 1936, is disclosed in the annual report of the South African Alkali, Ltd. Of the eleven million gallons of brine pumped during the year, nearly six million gallons were treated. The soda ash produced amounted to 1,700 tons from brine and 300 tons from trona. The capital expenditure during the year was £11,681.

Explosives

THE first stages of the great £1,500,000 expansion programme of the Modderfontein Dynamite Factory just outside Johannesburg, have been completed. Before the end of 1937 the entire plan for making this the largest single plant of its kind in the world will have been achieved. This plan called for almost doubling the large plant already at work. The plant will have an output of 1,600,000 cases, equal to 40,000 tons of dynamite per year.

From Vitamin C to Vitamin P*

By Professor A. SZENT-GYÖRGYI,
Professor of Organic and Medical Chemistry, University of Szeged, Hungary

MY first real interest in biochemistry was in the function of the adrenal cortex. At that time we only knew that this internal secretory gland was essential for life. Without this organ life failed. Furthermore, we knew that patients suffering from the deficiency of the gland turned brown before dying. Bananas and pears do the same. The pigmentation of dying vegetable tissues has been shown by Palladin, the Russian plant biochemist, to be due to a disturbance in oxidation-reduction equilibrium. So I hoped, oxidation-reduction processes will explain to me the function of the adrenal cortex. But we knew too little about oxidation systems too. So I set out to study first animal, and later vegetable, oxidation systems. The first systems analysed, that of succinic oxidation in muscle, and the polyphenoloxidase in potatoes gave me no clue, but while analysing the peroxydase systems in turnips, I found there was a substance present, which was capable of inhibiting the formation of melanoid pigments. This substance was a strong reducing agent, which reduced immediately oxidised phenols, before they could undergo further modification and form pigments. I isolated the substance and made its first approximate analysis, establishing its empirical formula and some of its more important characteristics.

Isolation and Identification

It was a great excitement, when I found the same substance in relatively big quantities in the adrenal cortex. The "isolation" and "identification" of this substance was not quite as easy, as writing these words down. It was not a simple matter and it need not only involved technical equipment, but also money and in the laboratory of the Physiological Institute of Groningen, Holland, where I was working at that time, none was available. Further researches on the isolation and identification were made possible by a friendly invitation by Professor F. G. Hopkins to join him at Cambridge, and by a generous grant from the Rockefeller Foundation.

Having established the main characteristics of this fascinating new substance I wanted to know more about it, especially its exact steric configuration, before attacking the problem of its biological activity. The trouble was, however, that I had too little of it, only a few milligrams and I could make no more, because of the labile nature of the substance. The only suitable material for large-scale preparations was the adrenal gland, which was not available in Europe in sufficient quantity. Professor A. Krogh, of Copenhagen, tried to help me by sending me adrenal glands from Denmark to Cambridge by air. The material, however, deteriorated during transit and was therefore useless.

Once more, international co-operation rendered fresh progress possible. Professor E. C. Kendall, of the Mayo Foundation, Rochester, invited me to the United States, and the rich resources of the Mayo Foundation together with the large quantity of material of the big American slaughter houses became available. The glands were packed in dry ice and shipped in this hard frozen condition to Rochester where the material was worked up; I was able to prepare as much as 25 g. of the substance.

Steric Configuration of Molecule

Returning from the United States I shared my substance with Professor Haworth, at Birmingham, who was deeply interested in it. His long-standing experience with carbohydrates, enabled him to investigate the steric configuration of the molecule. The substance unfortunately proved to be insufficient for the work and there was no chance of preparing it again.

After settling down to a more quiet life in my own country, in Szeged, Hungary, I found an opportunity, to put to the test an old suspicion of mine (for investigating which my earlier roaming life was unsuited): whether the substance, which I had in my hands for five years, was not identical with the long sought Vitamin C. I started the work in collaboration with a young American, Svirbely, in the autumn of 1932. In November, we had the first definite answer. The animals treated with our substance, which we used to call "hexuronic acid" all lived, while the controls all died. Owing, however, to defective diet (we had difficulty in securing milk powder), the weight curves were not satisfactory. So we repeated the whole experiment, before we published our result in March of the next year. Meanwhile, also King and Waugh, at Pittsburg, isolated from lemon juice, a crystalline substance which was antiscorbutically active and which resembled our preparation of hexuronic acid. Also Tillmans, in Germany, found at about the same time, a close parallel between the reducing power and vitamin content of plant juices, which made the identity of hexuronic acid and Vitamin C probable.

Our substance was thus, according to its newly discovered activity, rebaptised now, and called "ascorbic acid." By its vitamin nature the substance acquired increased importance and it was the more regrettable to have none of it. This difficulty was solved by an unforeseen discovery.

Szeged, the city in which my laboratory is situated, lies in the middle of the Hungarian paprica—red pepper, *Capsicum annuum*—fields. I once tested paprica for its Vitamin C content and found it a rich store house of Vitamin C. Large-scale preparation gave good yields and in two consecutive years I could prepare about 4 kg. of ascorbic acid, providing all laboratories of the world which were wanting to work on this substance with ample material. This work was not without results. Professor Haworth, at Birmingham, soon established the steric configuration of the substance and its synthesis was effected both by Reichstein at Zurich and by Haworth. In this way the most mysterious vitamin, which so long resisted analysis, succumbed to laboratory investigation. At present, it is produced synthetically on a big scale at a very low price, so that it is available for all those who are in need of it; and all this in the incredibly short time of hardly two years. This is what international collaboration and understanding can do.

An Essential Part of Our Diet

Further research showed ascorbic acid to be an essential part of our diet. I myself went back to my old line of research, *vis.*, oxidation, which led me to Vitamin C. I forgot ascorbic acid and the ascorbic acid people forgot me.

Only in the last months have old reminiscences begun to awake again. As I mentioned at the beginning, I was led to the discovery of ascorbic acid by the analysis of the peroxydase system. At that time I also found that peroxydase *plus* peroxide oxidised ascorbic acid reversibly. This reaction occurred only if there was an aromatic substance present, which induced the reaction. Peroxydase had no direct effect on ascorbic acid; it, however, oxidised aromatic substances to quinols which, in their turn, oxidised ascorbic acid. I wondered which aromatic substance was playing this rôle in the plant, especially in lemons. I was led to a very peculiar new substance, which seemed to belong to the widely spread group of vegetable benzo-pyran dyes, the flavons. I suspected that this substance might have a vitamin nature too. Only there was no animal test for its study. So I put the substance aside in the hope that at some later date I might find one such. Nature seems to have given us a suitable test in the form of certain human pathological conditions, such as the haemorrhagic diathesis (vascular type). My friend, St. Rusznyák, professor

* Reprinted from "Current Science," December, 1936.

of medicine, has told me that he had some very good cures for such conditions with paprika (red pepper), but the effect was not due to the ascorbic acid present. To what was it due then? The same effects could be obtained with lemon juice.

We therefore set out to investigate the question and to find the substance responsible for this activity. And in the end we found it. It was nothing else than my old friend, the flavone, carrying the reaction between peroxidase and ascorbic acid. The crystals of the substance had the same therapeutic effect as the whole pepper. They cured in a striking way disorders of the permeability of the capillary wall. So we gave the name "Vitamin P" to this flavone and we are hopeful that in its ability to reduce human suffering, this new substance will be no less important than ascorbic acid.

If the vitamin character of this substance be firmly established, this will also mean that the great group of vegetable dyes, the flavones, which seem to play such an important rôle in plant biochemistry, also function in the animal organism. So the substance will form a new chemical link between plant and animal physiology.

The researches on ascorbic acid described in this article serve to bring out certain features characteristic of modern research. Thus, work on some fundamental problems yields results quite unsought and opens up vistas quite unsuspected; rapid advance is dependent on international collaboration and in modern research investigations of micro-quantities of substances should proceed side by side with the preparation of materials on a large scale using tons of raw material.

Letters to the Editor

An Unfettered British Dyestuffs Industry

SIR,—Professor Armstrong is again on the war path, but his reference to the suggested modified position of the "Standard Instrument" of the "Industrial Organiser" is hardly voiced in the sentiments usually expected from him. Perhaps Professor Armstrong, looking down from his academic height and in his apparent "ignorance of the view point of the present-day industrialist" is not aware that he is setting Mr. Cronshaw an impossible task, insomuch as in these "monopolistic" and "cartel" days there is only one "dyestuffs" road (which is usually closed to fast or through traffic) and no "next street" in which to exploit one's talent.

A mildly interested but entirely non-academic individual might be allowed to ask Professor Armstrong and Mr. Cronshaw what their answers would be to the following questions:

(1) Why did Dr. Levinstein and Professor Green leave the dyestuffs industry at a time when they were the only active acknowledged scientists connected with it?

(2) Who broke up the band of workers gathered together by Dr. Levinstein?

(3) Was it in best interests of the industry that Dr. Levinstein and Professor Green left it when they did?

How history repeats itself. Answers to these questions may render unnecessary in years to come, arguments similar to the one under review, when someone jumps into print with the story of the immediate post-war record of the dyestuffs industry in England.

Possibly Professor Armstrong would agree that it is one of the few things in connection with "colour" which he cannot explain even to his own satisfaction, and Mr. Cronshaw from his more active association with the events of the time might reply, "In addition thereto," "in consequence thereof," "howsomever," "altogether," "whatever." He would no doubt endeavour to pronounce clearly the words "Industrial," "Political," and "Finesse," but not necessarily in that order.

However, long life to the venerable old gentleman of science and may his sons and grandsons grow to be like him in thought, word and achievement; and continued luck to the I.C.I. and may the protection afforded to its Dyestuffs Group by the Government last long enough to ensure a true unfettered British dyestuffs industry being stabilised in this country.

Then we may have a new "band" of scientists without "organs," "harps" or "big drums" equipped with instruments more in keeping with their profession, and a fine "next street" of freedom available for them to exploit their talents for the benefit of industry in general.

Meantime, the bones of the "Pioneers" will lie at rest, caring not a fig for the attack on their memories by the "mercenaries" of industry of to-day and regretting the nature of the defence of their good name by one of the last

of their generation, but feeling that most men of this generation who are interested in their discoveries will be proud to exclaim, "They were pioneers and cleverer men than we."—Yours faithfully,

GRADUATE OF ADVERSITY.

The Professional Consultant

SIR,—An important suggestion was made recently at a meeting of the Casual Club by Dr. J. F. Crowley, which seems from many points to demand serious attention at the present time. Quite obviously, through his wide experience in many countries he is specially qualified to express an opinion on the matter in question.

The point is this. In the future world-development of industrial science and practice, he had often noticed that when any exceptional work was contemplated, and a look-round was made for an appropriate expert to carry it out, in far too many instances, the present existing conditions led to some foreign expert being chosen. It was then quite natural that any plant and machinery required should come from his country of origin.

If this is so, this country is suffering in a direction which cannot be overlooked profitably from a national point of view. Beyond question there has of recent years been a strong tendency for our industrial concerns to rely more and more on the knowledge and experience of their own scientific and technical staffs. It is also an open secret that, generally speaking, the man who has prepared himself in this country for work of this character is too often grievously disappointed and discouraged with the indifferent call for his services. This at a time, if Dr. Crowley's diagnosis is correct, when the immediate future will see great developments abroad in industrial science.

It should be worth while for those interested in every direction to get together and by mutual agreement devise a position where the British expert should be far more generally recognised abroad. No longer does "trade follow the flag" as it used to for there is no longer any possible expansion in this direction which gave this country such opportunities in the past. It may well be that trade, in its development aspects, may follow the recognised expert. If this be so, it is up to us to put our special experts in a position where their work may become universally known and respected. From the point of view of fair play for experts in this country, it would certainly seem that Dr. Crowley's remarks should be more generally known, and seriously considered, before it is too late for their significance to be understood and appreciated.—Yours faithfully,

W. P. DREAPER.

London, N.W.3.

Sulphur and Other Rubber Vulcanising Agents

By T. L. GARNER, M.Sc., F.I.R.I.

THE successful development of the rubber industry dates from the time of the discovery of vulcanisation by Goodyear and Hancock about 1843, when it was found that the use of sulphur coupled with the action of heat brought about a fundamental change in the nature of rubber compounds. From this pioneer work have been developed the methods of vulcanisation which we know to-day, and without which only poor ageing rubber products would be possible.

Sulphur is universally employed to-day in the vulcanisation of rubber articles, and such other methods as have arisen from time to time have only achieved limited application as independent agents. The molecular complexity of sulphur depends upon the temperature, and up to its boiling point the molecule contains eight atoms. Above the boiling point temperature the molecule reduces in size until above 700° C. it corresponds to the formula S_2 . Weber considered that vulcanisation could only be carried on when S_8 molecules had dissociated into S_2 molecules, and since sulphur is only slightly dissociated at comparatively high temperature, a considerable excess was required in a rubber mixing for practical vulcanisation. This theory, however, is untenable in view of later research, and it is held at the present time that the different allotropic forms of sulphur which may be present normally in sulphur are remarkably little divergent in activity towards rubber (Twiss, "Trans. Inst. Rubber Ind.", 3, 386).

Solubility of Sulphur

Fortunately rubber is a solvent for sulphur, and this ensures a uniform distribution of the latter during the vulcanisation process, even if the usual mixing process has left the sulphur poorly dispersed. The solubility has been calculated to be as high as 20 per cent. at vulcanising temperatures (Kelly and Ayers, "Ind. Eng. Chem.", 1924, 16, 148), but falls to about 1 per cent. at ordinary temperatures. It will therefore be obvious that mixings containing not more than 1 per cent. of sulphur in uncombined state should never show an appreciable bloom; in practice, however, several factors may upset this calculation. It has often been observed that a mixing containing a high percentage of sulphur uncombined with the rubber shows less tendency to bloom than one having a much smaller amount; this is because the higher sulphur content ensures a crystallisation centre of undissolved sulphur within the rubber mass which leads to internal crystallisation of sulphur and consequently less blooming. A similar result can be effected by introducing relatively insoluble particles isomorphous with rhombic sulphur, thus forming a permanent internal crystallisation nuclei.

In uncured rubber mixings, which are often required with tacky surfaces, blooming and consequent destruction of the tackiness can be discouraged by maintaining uniform temperatures during stocking, preventing contact with sulphur and other isomorphous dust particularly from workers' hands, and by keeping temperatures low enough while mixing to ensure that a part of the sulphur remains undissolved. The use of sulphur containing a proportion of insoluble sulphur will also assist in the latter connection. Further, since sulphur is more soluble in vulcanised than unvulcanised rubber, the presence of reclaimed rubber in a mix lowers the tendency to develop bloom.

The amount of sulphur used in a rubber mixing to-day is usually small and may be as low as 1 per cent. when fast accelerators are present, and while it is generally accepted that some chemical combination between rubber and sulphur occurs, little is known as to the molecular composition of the products in soft vulcanised rubber. It is definite, however, in the latter case that the proportion of sulphur required is less than what would be required to form any simple rubber-sulphur compound. In the formation of hard rubber the essential constituent resulting is represented by the formula $C_{16} H_{14} S_4$.

Up to the present time vulcanisation with sulphur, with or without active accelerators and a heat process, has proved to be unequalled, but other methods, some involving sulphur products and others not, have been put forward and are used in special circumstances. The extended use of sulphur-containing accelerators, such as tetra ethyl thiram disulphide, which may be used if required without any added sulphur, has been one line of development to produce compounds of exceptional ageing properties and heat resistance. Frequently such rubber mixings are designed with a high accelerator content of the sulphur-bearing type with just a small percentage of added sulphur, *i.e.*, 0.5 to 1 per cent. This diminution of the sulphur ratio below that formerly regarded as desirable has been shown by heat and ageing tests to result in increasing stability. Extremely low percentages of sulphur, of the order of 0.2 per cent. can be used to give good commercial products if a secondary vulcanising agent, such as selenium or tellurium, is employed.

The advantages of these low sulphur compounds are primarily enhanced resistance to heat and ageing. Another important feature is that the rubber stocks are non-blooming and consequently colours can be retained much brighter than with the ordinary types of mix. Lower vulcanisation temperatures required for low sulphur stocks are also an advantage in preventing any discolouration of the rubber mix.

Research on Selenium

Considerable research has been carried out on selenium as a vulcanising agent. This element has similar properties to sulphur, but due to its higher atomic weight it is slower in action. It is generally recommended for use in conjunction with sulphur in the presence of organic accelerators, when it tends to reduce the blooming of sulphur in the vulcanised product. An excess of selenium produces a marked greenish-yellow bloom. Selenium, however, has not attained any great importance in this country, although extravagant claims for it have been made from time to time by American investigators. In particular it has been claimed by them that markedly improved resistance to abrasion results from vulcanisation of rubber with a suitable mixture of sulphur and selenium, but it has not been possible to confirm this desirable property. Several patents have been taken out for the use of organic compounds such as selenium diethyldithio-carbamate, which can effect vulcanisation when used in sufficient quantities.

Sulphur monochloride is used principally in the vulcanisation of thin rubber goods, such as dipped goods. A suitable tank may be filled with the vapour from the liquid and articles are cured by suspending them in the vapour at a temperature of approximately 180° F. for a period round about one hour. Alternatively, the article to be vulcanised is dipped into a solution of sulphur monochloride in carbon disulphide which varies in strength, but is usually a two per cent. solution. The time of cure varies with the thickness of the article, but is generally a matter of seconds only, and the article must be well washed after dipping. In both this and the former method it is essential to see that the article is thoroughly dry before vulcanising.

The Peachey Process

In the Peachey process of vulcanisation the rubber is saturated with the necessary amount of hydrogen sulphide and sulphur dioxide is then introduced to react and produce active sulphur; vulcanisation takes place rapidly and at ordinary temperatures. The method has not been widely adopted, but it has been put forward as a promising process where the rubber contains organic fillers such as leather or cotton, which are rapidly decomposed by the usual heat process. Vulcanisation by means of the haloids, and also by hypochlorites, has been put forward, but is of no commercial importance.

Ostromislensky in 1915 proposed the use of 1, 3, 5, trinitrobenzene as a vulcanising agent since when there has been considerable controversy on the value of the method, but among the claims put forward by the originator ("India Rubber World," 1929, 80, 55) are improved ageing properties, more rapid cure, vulcanisation at lower temperatures, and the use of various substances for incorporating into the mix which are not practicable in a sulphur mixing. Many investigators endeavouring to repeat the early experiments of Ostromislensky were unable to prepare a satisfactory vulcanisate and there is very little evidence available as to the practical use of this method in the rubber industry up to the present time.

In the case of soft rubber, using sulphur, vulcanisation involves a combination of part of the rubber with the sulphur, the remainder of the rubber undergoing a change, induced by this chemical action, the nature of which is not known. An added complication has arisen in the compounding of carbon black. This pigment when heavily compounded into rubber gives an unvulcanised rubber-black mix which is not soluble in the usual solvents and appears to possess the properties of a lightly vulcanised rubber (Stamberger, "Gummit-Zeitung," 1927, 41, 214); the presence of carbon back in unvulcanised rubber also interferes with the removability of free sulphur.

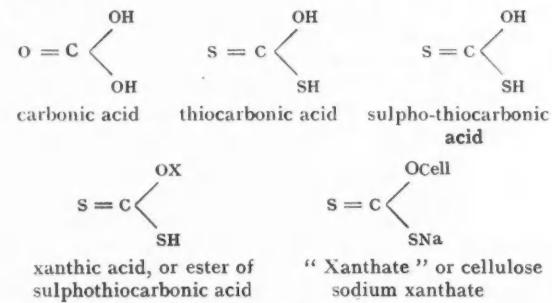
The Formation of a Viscose Thread

Chemical Theory

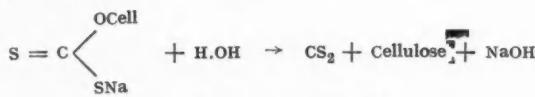
A VISCOSE rayon thread consists of substantially pure regenerated cellulose, said Mr. A. P. Backshell in a paper on "The Chemical Theory of the Formation of a Viscose Thread," read before a recent meeting of the Hull Chemical and Engineering Society.

When Cross, Bevan, and Beadle in 1892 discovered how to make viscose by the xanthate reaction, they regarded it as a possible vehicle for the dispersion and manipulation of cellulose into any desired form. More than a decade afterwards, the potentialities of viscose for the manufacture of synthetic fibres became evident, and such progress has since been made that the production of yarn by this method amounted to 939,660,000 lb. in 1935, and 498,240,000 lb. in the first half of 1936.

In virtue of its hydroxyl groups, cellulose can be regarded as an alcohol, which in common with other alcohols, forms a compound of the type $XONa$. Such sodium alcoholates may then be reacted with carbon bisulphide to give a sodium salt of a xanthogenic acid. The following table shows these relationships:



The xanthate so derived from cellulose, when dissolved in dilute caustic soda gives the highly viscous dispersion which the discoverers descriptively named "viscose." Reversal of the process or decomposition of the product regenerates cellulose.

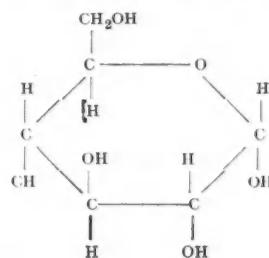


Ideal Stoichiometric Ratios

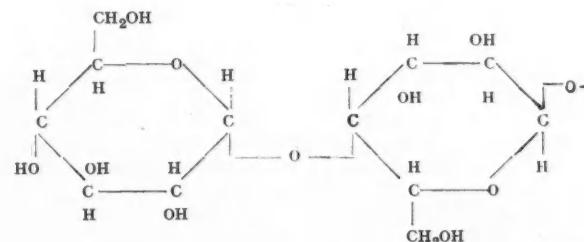
The reaction appears straightforward, and it seemed reasonable to suppose that if sodium, cellulose, and carbon bisulphide were present in definite molecular proportions, viscose of consistent properties would be obtained. A great deal of early work in the synthetic fibre industry was devoted to establishing the ideal stoichiometric ratios. No completely satisfactory conclusion was reached from the theoretical side, and practical experience led to the proportion of carbon bisul-

phide being reduced far more than seemed possible. The tendency to reduce the carbon bisulphide was emphasised by the fact that excess of this reagent tended to degrade the cellulose, and the minimum was employed consistent with a spinable viscose being obtained.

Haworth and his school have carried out much fundamental work on the structure of cellulose from the chemical side. They established firmly that the fundamental unit of cellulose is a six-membered ring— β -gluco-pyranose.



When a molecule of water is split off between two β -glucopyranose units, union takes place as indicated, the two rings being united through an oxygen bridge, linking the carbon atom adjacent to the oxygen in one unit with the carbon atom in the β position in the other. Continuing this process by further linking up of β -cellobiose units a long straight chain is obtained, in which CH_2OH groups alternate on the two sides of the ring planes



Haworth puts forward evidence to show that the cellulose molecule has a length due to a chain of some 200 β -glucopyranose units linked together by the primary valencies of the oxygen atoms. Such a single chain of glucose units would lead to a molecular weight for cellulose of 15,000-30,000. Sedimentation and viscosity measurements give consistently higher results than these, and a maximum value of about 300,000 has been obtained for cellulose obtained from natural fibres.

X-ray analysis adequately confirms the chemical evidence for the existence of the six-membered rings, and further de-

monger the aggregation of the chains into macro-molecules in which the chains lie parallel, and at definite distance apart. This regular spacing of atoms in three dimensions is an essential characteristic of crystals, and the parallel configuration of chains is typical of fibres. Such fibres as muscle protein and asbestos have similar structure.

Uniform Micelle Size

The prime desideratum in cellulose for rayon manufacture is large and uniform micelle size, absence of gummy impurities and mineral constituents, and a maximum of the -cellulose, insoluble in acid or alkali. Even mild oxidising or hydrolysing treatment gives oxy- or hydro-celluloses which have much shorter chains, are soluble in acid or alkali, and are consequently a source of loss or variability in rayon manufacture. Particular attention is therefore directed to minimising degradation in the pre-treatment of the raw material.

The proportions of reactants used have been arrived at empirically and on the manufacturing scale. They bear no very definite stoichiometric relations to one another. In fact, their interrelations can best be summed up by saying that the cellulose has been xanthated to such a degree that it will, after appropriate dilution and ripening, hold a definite proportion of water in the micelle, and consequently will give a dispersion of the desired viscosity.

It will be fairly clear that in any micelle, the internal hydroxyl groups will be occupied in holding together parallel glucosidic chains, and that only the outside and end hydroxyl groups will be available for xanthation. Thus, the solid geometry of the case suggests that the larger the micelle, the fewer the surface hydroxyl groups and the less carbon bisulphide will be required for xanthation.

During the storage period the xanthate tends to break down into cellulose, carbon dioxide, carbon bisulphide, thiocarbonates and other sulphur compounds. As the cellulose : sulphur ratio in the micelle increases, the water holding power of the agglomerate decreases. Water passes from the colloid to the disperse phase, with reduction of the viscosity of the viscose. Finally such a viscosity is reached that the viscose can be spun readily at reasonable pressures. Further ripening of the viscose beyond this stage results in the coagulation of the gel. Tests for readiness for spinning comprise viscosity, estimation of the minimum concentration of salt required to coagulate the viscose, and estimation of the proportions of sulphur present in the xanthate and in the by-products. Estimation of the combined soda and sulphur indicate that the cellulose complex has the composition $(C_6H_{10}O_5)_3CS_2 \cdot NaOH$.

The Spinning Operation

In the spinning operation the viscose passes through minute circular holes in the jet and forms a corresponding number of fine streams, which after coagulation gives a thread. For the first few fractions of a millimeter of travel, the stream of viscose consists of an outer skin enclosing a liquid core. The skin, acting as a semi-permeable membrane, permits the passage of water from the medium of low osmotic pressure inside the skin to the region of higher pressure in the spinning bath. This loss of water reduces the volume of the contents of the skin which wrinkles longitudinally to accommodate itself and results in the serrated cross section which is typical of good quality viscose yarn. During this process the filament becomes a plastic solid. According to the tension applied to the filaments at this stage, and to the temperature of the bath, the cellulose micellæ are orientated more or less parallel to the axis of the filament.

Fine control in spinning is introduced by the use of special small pumps, one to each jet, capable of delivering from 4 to 100 grammes of viscose per minute, according to adjustment, with a maximum variation of one per cent. To ensure equal quantity of viscose passing each hole, and hence uniform filaments, no appreciable variation is permitted in the orifice size. Moreover, the internal surfaces of the hole must be quite smooth, or the delicate filaments are likely to be imperfectly formed and to break.

A most prolific source of clogging of the jets is the presence of hardwater salts—which may be introduced either into the viscose or into the spinning bath—or the presence of calcium in the wood pulp. Softened water is therefore used throughout the process, and sodium sulphite is added to the churning during xanthation. Any calcium present forms the insoluble sulphite, which can be removed by filtration. Assuming that viscose is fed at constant rate to clean jets, another and most important factor comes into play—the tension put upon the coagulating filament by the godet.

The counsel of perfection in attaining good strength is to start with a good material and to treat it well. At the mercerising stage, excessive oxidation must be prevented, since this, by forming very short molecules of hydro- or oxy-celluloses, and by encouraging intra-molecular water adsorption, still more deteriorates the wet strength. The application of tension to the thread during formation, by orientating the micellæ parallel to the long axis, tends to raise the tenacity. It is clear that such a process cannot be continued indefinitely, and that there will be a limit to the ultimate strength. Further, as orientation becomes more complete, the elongation of the material on applying tension will become less.

Non-Ferrous Welding

Unsatisfactory Electrodes

METALLIC arc welding of non-ferrous metals is limited in its progress by the amount of attention which the electrode manufacturers have to spare from their frenzied efforts to make cheaper electrodes for mild steel, said Mr. H. G. W. Hignett, in a paper on "Non-Ferrous Welding" read before the Birmingham Section of the Institute of Metals on February 19. Until quite recently, no serious efforts have been made to produce satisfactory coated electrodes for non-ferrous metals. In the case of nickel, for example, the main object appears to have been to discover the maximum amount of deoxidant of any kind which can possibly be introduced into an electrode coating. As much as 2 per cent. of carbon has been found in the deposits from some of the results of these efforts.

The advantages of the metallic arc process are high welding speed and reduced distortion: its disadvantages are the production of high residual stress and the need for careful preparation of the work. The very local heating makes the process readily applicable to materials of low thermal conductivity, if the results of internal stress can be avoided. With the latest types of electrode, welds on nickel and alloys can be produced to compare favourably with the best oxy-acetylene welds. With materials of high thermal conductivity it is difficult to supply sufficient heat to the parent metal and, at the same time, to preserve an arc in which the transfer of molten metal is under control. In the case of copper, a novel attempt to solve this problem has been made by Matting and Lessel, whose "Schlauchelektrode" has four distinct coatings designed to give an extremely long arc, in which, however, the molten metal is protected from oxidation. Coated phosphor bronze electrodes have been used for some time for welding copper, but preheating is always necessary. Aluminium electrodes are now available in which excessive deliquescence of the coatings has been avoided without destroying the useful properties of the flux. The cores usually contain 5 per cent. silicon and some preheating is needed, except on thin material.

The powerful reducing action obtained in the atomic hydrogen welding process makes a flux unnecessary in most cases (excepting aluminium) and accounts for the remarkable cleanliness of the welds produced in many materials. On the other hand, the gas is readily dissolved by many molten metals, and evolved again during freezing, which as a result of the concentrated source of heat is often so rapid as to trap the evolved gas in the form of blowholes. The atomic hydrogen process is particularly suitable for high melting point nickel chromium alloys and for monel metal.

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I.C.I. Capital Reduction

Reasons for House of Lords Approval

THE House of Lords on Monday gave reasons for their decisions last November, dismissing an appeal against a judgment of the Court of Appeal sanctioning a reduction in the capital of Imperial Chemical Industries, by £5,434,141, and approving a scheme of capital reconstruction.

The appellant was Mr. John Kennedy Carruth, on behalf of himself and other deferred shareholders in the company. The appeal was heard before Lord Blanesburgh, Lord Russell of Killowen and Lord Maugham.

Lord Blanesburgh, in his judgment, states that he came to the conclusion that the assumption that the burden of the capital reduction fell exclusively upon the deferred shares was mistaken, and that, in the absence of class consent, it was for the company to establish affirmatively that the reduction was fair and equitable to the deferred shareholders. He was satisfied that the company had done this, and therefore he concurred in the order of the House which, in effect, confirmed the reduction.

The real contest was as to the fairness to the deferred shareholders of the exchange of four deferred shares for one ordinary share. On this point he was content to accept the opinion of Sir Albert Wyon and Sir William McLintock that, in their judgment, the scheme was entirely fair to the deferred shareholders.

In regard to costs, Lord Blanesburgh said that, in recognition of the assistance rendered to the House by Mr. Carruth, the I.C.I. should bear their own costs of the appeal.

Lord Russell of Killowen and Lord Maugham also delivered judgments in support of their conclusion that the appeal should be dismissed, without costs, and this was done.

British Overseas Chemical Trade in February

According to the Board of Trade returns for the month ended February 28, 1937, exports of chemicals, drugs, dyes and colours were valued at £2,015,509, as compared with £1,662,654 for February, 1936, an increase of £352,855. Imports were valued at £961,221, as compared with £905,334 for February, 1936, an increase of £55,054. Re-exports were valued at £30,501.

	Quantities.	Value.	Quantities.	Value.
	February 28. 1936.	February 28. 1937.	February 28. 1936.	February 28. 1937.
Imports				
Acids—			Drugs, medicines and medicinal preparations—	
Acetic .. cwt.	11,590	16,266	Manufactured or prepared—	
Boric (boracic) ..	8,000	2,500	Quinine and quinine salts .. oz.	66,406 106,601
Citric	3,567	2,406	Medicinal oils .. cwt.	5,673 2,636
Tartaric	3,845	1,218	Proprietary medicines .. value	11,197 5,684
all other sorts .. value	—	—	All other sorts	— 30,967
Borax cwt.	7,901	210	Dyes and dye-stuffs and extracts for tanning—	— 45,133
Calcium carbide	84,995	69,393	Finished dye-stuffs from coal tar cwt.	— 53,071
Fertilisers, manufactured—			Extracts for dyeing	4,462 125,686
Superphosphate of lime tons	2,808	1,729	Extracts for tanning (solid or liquid)—	6,168 14,224
All other descriptions ..	1,704	1,361	Chestnut	21,977 11,316
Phosphorus .. Cwt.	—	—	Quebracho	72,173 106,527
Potassium compounds—			All other sorts	23,232 12,503
Caustic and lyes ..	9,288	8,628	All other dyes and dye-stuffs .. cwt.	1,159 14,495
Chloride (muriate) ..	23,080	26,380	Painters' colours and materials—	
Kainite and mineral fertiliser salts, elsewhere specified .. cwt.	—	—	White lead (basic carbonate) cwt.	6,681 8,368
Nitrate (saltpetre) ..	5,295	6,506	Lithopone	18,514 4,528
Sulphate	14,970	11,170	Ochres and earth colours .. cwt.	23,899 14,144
All other compounds ..	9,131	8,570	Bronze powders	14,990 52,621
Sodium compounds—			Carbon blacks	1,470 5,016
Carbonate, including crystals, ash and bicarbonate .. cwt.	451	317	Other pigments and extenders cwt.	25,539 14,709
Chromate and bichromate cwt.	1,895	3,029	All other descriptions	20,408 11,551
Cyanide	4,714	2,158	All other descriptions	12,812 58,527
Nitrate	12,000	115,780	All other descriptions	14,985 30,358
All other compounds ..	31,841	23,891	Total value	905,334 961,221
Other chemical manufacturers value	—	—	Exports	
Acids—			Sulphate, including saltcake cwt.	17,737 44,921
Citric cwt.	2,235	1,569	All other sorts	57,426 72,432
All other sorts .. value	—	—	Zinc oxide .. tons	1,340 1,153
Aluminium compounds tons	1,811	2,032	All other descriptions	
Ammonium compounds—			value	—
Sulphate .. tons	14,537	23,706	Drugs, medicines and medicinal preparations—	174,642 184,904
All other sorts	5,457	1,454	Quinine and quinine salts .. oz.	111,613 256,446
Bleaching materials—			Proprietary medicines .. value	11,157 23,295
Bleaching powder (chloride of lime) .. cwt.	44,771	50,420	All other descriptions	133,026 128,496
All other sorts	6,861	4,415	Dyes and dye-stuffs and tanning—	129,570 133,278
Coal tar products—			Finished dye-stuffs from coal tar—	
Cresylic acid .. galls.	169,081	263,288	Alizarine, alizarine red ..	
Tar oil, creosote oil, an, thracene oil .. galls.	2,013,849	2,679,672	indigo (synthetic) .. cwt.	2,128 2,604
All other sorts .. value	—	—	Other sorts	6,812 7,851
Copper, sulphate of tons	3,035	6,310	Extracts for tanning (solid or liquid) .. cwt.	13,845 17,172
Disinfectants, insecticides, weed killers .. cwt.	23,914	28,596	All other descriptions	1,671 12,215
Fertilisers, manufactured, tons	19,785	36,500	Painters' colours and materials—	14,208 9,810
Glycerine .. cwt.	8,962	12,549	Ochres and earth colours .. cwt.	11,270 12,028
Lead compounds	12,622	11,123	Other descriptions	18,000 23,735
Magnesium compounds tons	367	412	White lead	6,453 4,409
Potassium compounds cwt.	5,943	3,508	Paints and painters' enamels, prepared	34,187 91,200
Salt (sodium chloride) tons	20,272	17,285	Varnish and lacquer (clear) .. galls.	70,596 26,739
Sodium compounds—			Printers' ink .. cwt.	4,670 26,560
Carbonate, including crystals, ash and bicarbonate .. cwt.	295,588	543,321	All other descriptions	35,756 23,551
Caustic	167,349	224,937	Total value	71,352 97,099
Nitrate	11,282	50	Total value	— 1,662,654 2,015,509
Chemical manufactures and products .. value	—	—	Re-Exports	
Drugs, medicines and medicinal preparations	—	—	Painters' colours and materials cwt.	338 1,603
Dyes and dye-stuffs cwt.	1,221	2,007	Total value	1,428 1,169

Chemical Notes from Foreign Sources

Austria

A NEW CHEMICAL MANUFACTURING COMPANY, the Salvis A. G., für Nährmittel und Chemische Industrie, has been registered in Vienna with a share capital of 300,000 schillings.

China

A TUNG OIL REFINERY IS PLANNED by the China Vegetable Oil Refinery Corporation, Ltd., for erection in Eastern Tschekiang, an important tung oil region.

Holland

THE ELECTRO CO., OF AMSTERDAM, one of the largest producers of oxygen and hydrogen in Holland, have declared an interim dividend of 3½ per cent. Last year no interim dividend was paid, only a final payment of 4 per cent., but business has much improved.

Czechoslovakia

CASEIN ARTIFICIAL WOOL will be manufactured on the initiative of a group of woollen manufacturers in Brunn, who have acquired an exclusive licence for the Italian lanital process. A new company with a capital of 30 million crowns will be floated for this purpose, a large proportion of which will be taken up by the Aussig Verein.

Italy

HYDROGENATION PLANTS NOW UNDER CONSTRUCTION at Bari and Livorno will utilise Albanian crude oil as well as lignite from Tuscany. Hydrogenation will increase the petrol content of the crude oil to 80 per cent. (originally 40 per cent.), as well as producing high-grade lubricating oils.

ANNUAL PRODUCTION OF POTASSIUM SALTS from molasses residues at the plant put into operation by L'Appula Soc. Anon., 1935, is now reported to be 4,000 tons. The range of salts produced includes the chloride, sulphate, bicarbonate, hydroxide and metabisulphite.

LABORATORY TESTS BY THE MONTECATINI CONCERN on the production of potassium compounds from leucite have given such encouraging results that it is hoped to be able to produce caustic potash, potassium carbonate and potassium nitrate to the annual value of 20 million lire.

Russia

AN EXPERIMENTAL PLANT FOR MAKING FORMALDEHYDE from natural gas has been built at Baku by the Ssojusgas Trust. Various types of contact equipment are being tried out to provide data for large-scale operation.

TUNG TREES ARE TO BE PLANTED over an area of 100,000 acres in the Black Sea region, using 40 tons of tung oil seed recently purchased by a special commission in the United States.

XENON AND KRYPTON ARE TO BE isolated at the Makejevka Metallurgical Works, with an annual output of 500 cubic metres. It is proposed to use a mixture of the two gases for filling electric lamps.

LUMINESCENT ZINC SULPHIDE is prepared, according to Holbreich, from zinc salt solutions which have been purified from heavy metal impurities by precipitation with a little hydrogen sulphide under conditions preventing separation of zinc sulphide. This can be effected, for example, by adding enough sulphuric acid to a solution of zinc ammonium sulphate to give a normal acid solution. This is followed by addition of hydrogen sulphide in quantity sufficient to give a concentration of 0.004 mol per litre. After 10 to 15 minutes the sulphuric acid is neutralised by gradual addition of progressively decreasing quantities of ammonia at a rate sufficient to reduce the acidity by one-half every 5 minutes ("J. Prikl. Chim.", 1936, No. 4, p. 670).

France

THE 40-HOUR WEEK HAS BEEN INTRODUCED in the chemical industry and wages have simultaneously been increased by 8.5 per cent.

Roumania

THE HERMES VEGETABLE OIL CO. is to manufacture stearine for the manufacture of candles. This product has hitherto been imported, largely from Hungary.

Hungary

RAPID PROGRESS HAS BEEN MADE in the installation of alkali chloride electrolysis plant by the Hungaria Artificial Fertiliser Works, of Budapest, and the first batch of caustic soda is expected to be on the market in a few weeks. With an annual production capacity of 300 tons, the new installation will cover about one-third of the home consumption. The same concern has also commenced the manufacture of sodium hydro-sulphite and a product of the zinc formaldehyde sulphoxylate type.

Sweden

A PLANT FOR IMPREGNATING PIT PROP WOOD with arsenic is to be built by the Bolidens Grav A/B.

OILCLOTH MANUFACTURE will shortly commence on a small scale at Anneberg (Smaland), in a disused match factory.

OVER-PRODUCTION OF SULPHITE ALCOHOL has compelled the authorities to prohibit the erection of new plants until further notice.

THE A/B NITROGLYCERIN, of Gyttorp, announces a net profit for the past year of 562,000 kronen (455,000 previously) and is distributing a dividend of 10 per cent. (unchanged).

France

A PERMANENT DULL FINISH is imparted to silk by passing it through a bath of viscose containing crystalline barium hydroxide kept at a temperature of 0° to 15° C. Recommended proportions of ingredients are viscose 100 to 200, barium hydroxide 60 to 120 and sufficient water to make up 1,000 parts. A non-ripened viscose is used. After immersion, the silk is squeezed out and then dipped in cold dilute sulphuric acid when barium sulphate precipitates upon the fibre. The silk is finally washed thoroughly with water before going through the usual treatment preceding dyeing (Gillet, "Fils et Tissus," 1936, p. 699).

Japan

PAINTS AND VARNISHES WILL BE MADE in Bucharest by the newly registered Industria Lutului S.A.R. (capital 1½ million lei).

VANILLIN IS NOW IN PRODUCTION at the new factory near Osaka, of the Nippon Koryo Yakuhin K.K. (Japanese Perfume Chemical Co.), who also obtain benzidine as a by-product.

TWO PROCESSES FOR EXTRACTING POTASSIUM SALTS from molasses have been developed by a Japanese professor, who claims to recover 95 per cent. of the potassium present. In the past no potassium salts have been made in Japanese distilleries.

THE ORIENTAL DEVELOPMENT CO. is erecting plant in Korea for the manufacture of alcohol from timber waste by a German process. Production will start at an initial capacity of 60,000 metric tons a year. The company will receive a heavy subsidy for the first two years, and will enjoy monopoly rights.

New Technical Books

NEW PRACTICAL CHEMISTRY. By Newton H. Black and James B. Conant. New York: The Macmillan Co. Pp. 621. 7s. 6d.

In this textbook the authors have tried to arouse the pupil's interest in chemistry by stimulating his curiosity concerning the nature of the common things in his environment. With this in mind they have suggested many classroom experiments for the teacher at the lecture table and have called attention to numerous applications of chemistry in the pupil's everyday life. The discussion of modern theories on the structure of matter has been put in a form as simple as possible with such a highly technical material, and has been limited to what is necessary for an understanding of fundamental principles. The matter relating to metals has been arranged with a view to emphasising the general processes of metallurgy and the real uses of metals in modern life. An encyclopedic compiling of more or less useful information about the extraction, properties, uses, and compounds of metals has been avoided.

* * *

NEW LABORATORY EXPERIMENTS IN PRACTICAL CHEMISTRY. By Newton H. Black. New York: The Macmillan Co. Pp. 193. 5s.

This book has been arranged to accompany Black and Conant's "New Practical Chemistry." The directions are framed primarily to meet the needs of students who are studying the subject for the first time. The directions as given at first are very full and detailed, but they are gradually abbreviated in order to leave more and more to the student's own initiative and imagination. Frequent questions (in italics) have been inserted in the directions to focus the attention of the student on the important facts to be observed. Introductory paragraphs are inserted to give the setting of the experiment and to indicate its significance.

* * *

PRELUDE TO CHEMISTRY: AN OUTLINE OF ALCHEMY, ITS LITERATURE AND RELATIONSHIPS. By John Read. Pp. 328. G. Bell and Sons, Ltd. 12s. 6d.

THE aim of this book is to offer a bird's-eye view of alchemy, followed by a closer glimpse of certain aspects. Its subject matter has accumulated naturally out of lectures of a historical kind which the author has given to general audiences on various occasions. The numerous illustrations, of which there are over one hundred selected from rare books and manuscripts, are a special feature in that they give a pictorial expression of the alchemical theories and help us to understand the inner working of the alchemist's mind. Too many writers have interpreted "alchemy" in a restricted sense as the pretended art of transmuting the so-called "base" metals into the "noble" metals (silver and gold), but here Professor Read has given us ample proof that alchemy was really a system of philosophy which claimed to penetrate the mystery of life as well as the formation of inanimate substances. Alchemical ideas appear to have arisen in China as early as the 5th century B.C., and the study was actively pursued in that country from B.C. 300 onwards. During the period from the 7th to the 13th century it became a special study of the Muslims, whose writings give evidence of notable advances, not only in alchemy itself, but also in mathematics, astronomy and medicine. During the 12th century the literature of the Islamic school began to percolate, by way of Spain, into Western Europe, and the new learning was eagerly taken up by scholars of those days. European writings then led to a much wider dissemination of alchemical ideas, which were readily distorted by copyists and commentators simultaneously with the handing on of that great possibility of producing gold by artificial means. "Gold making" reached its heyday during the 16th century, when Paris, Prague and other European cities housed numerous alchemical workshops in which the strange craft was prosecuted with feverish vigour. Liberated gradually from its main obsession of gold making,

alchemy then changed imperceptibly into chemistry. Professor Read unfolds the story in an absorbing manner, and has many interesting sidelights to reveal before the reader gets to the day when the composition of the ancient elements—air and water—was finally discovered, and "different kinds of air" were recognised by Priestley in 1774.

* * *

THE STRUCTURE OF METALLIC COATINGS, FILMS AND SURFACES.

A General Discussion of the Faraday Society. Pp. 1,290 and 77 plates. London: Gurney and Jackson, 21s.

The pages here reprinted from the "Transactions of the Faraday Society" are divided into two broad sections: electron diffraction methods and the structure of metallic coatings. The study of surfaces by means of diffracted electron beams has been very fruitful, and has been summed up by Professor Finch, whose contribution shows that although there is still room for differences in regard to the interpretation of some of the experimental results, this new method of investigation is remarkably helpful, and is probably the most powerful means as yet available for the examination of surface films. On the question of the Beilby layer on polished surfaces, the evidence produced as to the existence of such a layer and the approximate order of its thickness on metals is said to be conclusive. Reference is made to Beilby's own measurements of the thickness of the polished film on calcite by chemical methods. Many of the contributions illustrate the difficulties involved in drawing conclusions as to the structure of metallic surfaces. Such surfaces are rarely free from gases, which may affect their structure. Even evaporated and sputtered films are produced in contact with gas which, even in as good a vacuum as is practicable, is not negligible in relation to films only a few atoms thick. Remarkable results are recorded by Professor Andrade. That minute micro-crystals should migrate and build themselves up into spherulite is a surprising observation, especially as it is also found that crystals of gold of 1μ or 2μ diameter, grown from solution or in silica gel, likewise show a spherulitic structure. The work of Mr. Macnaughton and others has shown that nickel hydroxide is mainly responsible for the hard deposits of nickel obtained from solutions of high pH value. In regard to electrolytic deposits the nature of the particles which may be included, and their effects in causing abnormal growths, have been examined systematically by Professor Portevin and M. Cymboliste, whilst Professor Glazunow, in the course of the discussion, called attention to previous publications in which he has indicated a mechanism for the influence of dendritic growth on the structure of deposits. New facts have been brought forward concerning the conditions under which the crystal structure of the basis metal may be continued by the deposit, and Professor Portevin calls attention to the resemblance between this effect and the well-defined parallel association in minerals. The papers by Professor Schlotter and Dr. Glasstone show that it is not necessary that actually precipitated matter should be carried into the cathode for interference with crystal growth to take place, since positive complex ions may pass to the cathode, and there decomposing produce insoluble substances which produce the effect. The individual papers and the full discussion which follows provides a very complete survey of the subject chosen, and the opportunity of comparing the views of different investigators has been most valuable. As regards methods of investigation, it is clear that whilst the method of electron beam diffraction is invaluable in the examination of very thin surface layers, X-rays, methods depending on the optical properties of surfaces, electrolytic potential measurements, microscopical examination, and the determination of mechanical properties such as hardness, are all essential in the study of the very numerous factors which determine the structure of surfaces and metallic coatings.

Personal Notes

MR. H. M. SINCLAIR, lecturer in biochemistry at University College, Oxford, has been elected to a fellowship on the foundation of Dr. John Radcliffe. He was formerly a Radcliffe Scholar in Pharmacology.

MR. A. GALLENKAMP, founder of A. Gallenkamp and Co., Ltd., has died in his 89th year. Mr. Gallenkamp, a man of extraordinary ability, retired from business in 1917 and enjoyed many peaceful years surrounded by a large library.

COLONEL N. T. BELAIEW, of Paris, and M. ALOYSE MEYER, of Luxembourg, have been awarded the 1936 Bessemer Gold Medals of the Iron and Steel Institute. Colonel Belaiew has published a number of papers of outstanding importance on the crystallisation of metals, especially steel. M. Meyer is head of the Société Anonyme Arbed, the Luxembourg combine and second largest iron and steel company in Europe.

MR. W. J. U. WOOLCOCK was in the chair at the Saturday night House Dinner at the Savage Club, on March 13. The event had a distinct chemical flavour. The menu was in keeping; for example, the soup was described as "Asparagine," with the chemical formula $C_11H_{21}N_2O_4$, the fish as "Codine" ($C_{18}H_{21}NO_4H_2O$) and the sweets as "Nitre Cake" ($NaHSO_4$). The evening demonstrated, as all the others of the session have done, that the irrepressible Savages are not in the least abashed by the stately surroundings of their new abode in Carlton House Terrace.

VISCOUNT WOLMER, who joined the board of Boots Pure Drug Co., Ltd., in October, 1933, has been elected first vice-chairman of the company.

DR. A. J. G. BARNETT, lecturer in chemistry, Education Department, Nigeria, has been elected a Fellow of the Royal Society of Edinburgh.

MR. JAMES TENNANT FORGIE, of Hamilton, Scotland, a director of the National Benzole Co. and of William Baird and Co., left estate valued at £297,802.

THE DUKE OF KENT will open, on April 14, at Bolsover, Derbyshire, the new plant erected there by Low Temperature Carbonisation, Ltd., an event postponed from last December. The new works are the largest of their type in the world.

THE FOLLOWING were elected to membership at a meeting of the board of the Institute of Physics on March 10: Fellows:—D. A. Oliver, A. J. Philpot, B. D. Porritt, D. M. Smith, H. G. Taylor and C. G. Winson. Associates:—J. T. Bain, C. Baker, F. M. Bruce, A. E. Bryan, T. Fairley, L. L. Fox, K. M. Greenland, S. P. Hillson, A. R. Hogg, J. W. Illingworth, J. H. H. Merriman, W. J. Mitchell, L. Rotherham, A. I. Van Geens, and W. H. Walton. Ordinary members:—J. W. T. Eytom. Students:—J. W. Blinkhorn, R. I. Garrod, A. F. Henson, T. B. Lane, C. C. Mill, J. Paine, K. J. Proud, C. V. Smith, M. Stephenson, E. C. Williams, and N. N. Winogradoff.

From Week to Week

SCOTTISH OILS, LTD., are extending their premises and erecting new plant at a cost of £42,000, consequent on the removal of the depot from Uphall to Grangemouth.

AN APPEAL to members of the Pharmaceutical Society to direct their attention to anti-gas measures was made by the Lord Mayor of Nottingham (Councillor E. Purser), speaking at the annual dinner of the Nottingham branch on March 11.

THE BRITISH INDUSTRIES FAIR of 1938 will be held in London and Birmingham from February 21 to March 4. The total attendance at this year's Fair in London was 223,398 as against 221,383 last year, and in Birmingham 152,649 as against 143,783 for 1936.

THE ROYAL DUTCH SHELL GROUP have placed an order for three tankers each of 12,100 tons with the Rotterdamsche Droogdok Maats. These vessels will be of similar construction to others which have already been turned out from the same yards.

JOHN BOWES AND PARTNERS, LTD., colliery owners, have decided to close down their Marley Hill coke works and by-product plant, which employs about 250 men, in September. The contracts at present in hand at these works are to be transferred to the new plant at Hebburn-on-Tyne.

LACRINOID PRODUCTS, LTD., announces that work on extensions to its factory at Gidea Park, Essex, will last eight weeks. New plant will be available simultaneously with the completion of these extensions. This additional plant is required owing to the increasing demand for the company's products.

BRITISH GLUES AND CHEMICALS have placed an order with the Liverpool Refrigeration Co., Ltd., for a complete refrigerating plant, which will include a "Polar" twin cylinder, single acting, sleeve valve compressor, vee belt driven, evaporator immersed in brine tank, condenser and pumps, etc.

ON THE EVE OF HIS DEPARTURE from Trinidad, on March 15, Sir John Cadman, who has been investigating the oil resources of the colony, stated that the main resources probably had not ever been tapped. He expressed the opinion that the present supply (which made Trinidad the largest producer of petroleum within the Empire in 1934) was furnished by seepage from prolific oil-bearing rocks below.

TO COMMEMORATE THE WORK of the late Mr. William James, the first hon. treasurer and one of the founders, the council of the Electrodepositors' Technical Society has inaugurated two annual prizes for the best essays or papers written by a student, apprentice, learner or other young person connected with, or interested in, the electrodeposition of metals. Manuscripts must be sent to the hon. secretary on or before May 10.

A MEETING OF THE MANCHESTER SECTION of the Institution of the Rubber Industry was held at Manchester, on March 15, when Dr. J. G. Mackay, B.Sc., A.I.C., read a paper on "The Evaluation and Control of Quality of Rubber Products." Mr. E. P. Rydings, B.Sc., A.I.C., F.I.R.I., presided. Dr. Mackay said that a system of evaluation was first made available by Henriques at the beginning of the present century, when the best world rubbers were commanding high prices. He discussed the problems of curing, compression testing, and abrasion testing, as well as to the Admiralty test for ageing.

THE IMPORT DUTIES ADVISORY COMMITTEE has received an application for an increase in the import duty on potassium and sodium ferrocyanides. Representations should be addressed in writing to the Secretary, Import Duties Advisory Committee, Shell-Mex House, Strand, London, W.C.2, not later than April 8.

THE VALUE OF THE CHEMIST TO THE TANNING TRADE was stressed by Mr. G. E. Knowles, F.I.C., in an address to members of the Liverpool and North-Western Section of the Institute of Chemistry on March 11. Many exhibits of various kinds of leather were shown. The following new associates of the Institute were formally admitted:—L. V. Cocks; H. M. Thompson, G. F. J. Mansell, R. E. Peel, N. F. Proudfoot, H. Weatherall, and C. H. Wood.

PRESIDING AT THE ANNUAL MEETING of the English China Clays, Ltd., Mr. R. Martin, chairman and managing director, referred to the fact that the china clay industry exported nearly two-thirds of its output. In the home market there was a decided improvement, mainly as a result of increased consumption. Previous to the erection of the company's central power station considerable trouble was experienced in the pits during the winter months through excessive rain, but since November last, despite the fact that the rainfall in Cornwall has been so heavy, they had been able to deal with the surplus water quite satisfactorily.

Forthcoming Events

LONDON.

Mar. 22.—Institution of the Rubber Industry. (Sales Section). "The Use of Rubber in the Agricultural Industry." Alexander Hay. 7.30 p.m. British Empire Club, 12 St. James's Square, London.

Mar. 24.—Institution of Chemical Engineers. "Prevention of Disease in Industry." Dr. Donald Hunter. 6 p.m. Rooms of the Chemical Society, Burlington House, Piccadilly, London.

GLASGOW.

Mar. 25.—Institute of Vitreous Enamellers. (Scottish Section). "Some Defects in Cast-Iron Enamels." J. G. Roberts. 7.30 p.m. Royal Technical College, Glasgow.

HULL.

Mar. 23.—Hull Chemical and Engineering Society. "Solvent Refining of Lubricating Oils." G. J. C. Vineall. 7.45 p.m. Room 57, Municipal Technical College, Park Street, Hull.

MANCHESTER.

Mar. 25.—Institute of Chemistry. (Manchester Section). Annual General Meeting. "The Policy and Future of the Institute." R. B. Pilcher. 7 p.m. Constitutional Club, St. Ann's Street, Manchester.

NEWCASTLE-UPON-TYNE.

Mar. 22.—Society of Chemical Industry. (Newcastle-upon-Tyne Section). "The Recovery of Sulphur from Smelter Gases." M. P. Appleby. 7.30 p.m. Chemistry Lecture Theatre, Armstrong College, Newcastle-upon-Tyne.

Inventions in the Chemical Industry

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Open to Public Inspection

PRODUCTION OF COMPOSITE PIGMENTS.—Titan Co., Inc. Aug. 24, 1935. 23144/36.

PROCESS OF AND APPARATUS FOR MAKING FERTILISERS, soil-improving agents, or other hygienically unobjectionable substances from organic matter, particularly waste material.—K. Petersen. Aug. 26, 1935. 23269/36.

PHOTOGRAPHIC PRODUCTION OF COLOUR PICTURES.—I. G. Farbenindustrie. Aug. 30, 1935. 23428/36.

RESINOUS COMPOSITIONS.—British Thomson-Houston Co., Ltd. Aug. 31, 1935. 23438/36.

RUBBER-PARACUMARONE-RESIN COMPOSITION and process of making same.—Barrett Co. Aug. 26, 1935. 23455/36.

PROCESS FOR TREATING SYLVINITE ORES and product or products obtained thereby.—Potash Co. of America. Aug. 28, 1935. 23467/36.

PROCESS AND APPARATUS FOR THE MANUFACTURE OF ZINC DUST.—Alloys Co. Aug. 30, 1935. 23813/36.

PROCESSES FOR THE MANUFACTURE OF HALF-CONDENSED ARTIFICIAL RESINS SOLUBLE IN WATER, specially prepared for the treatment of yarns and tissues consisting of vegetable, natural, or artificial fibres and/or animal fibres.—Pagani and Co. Aug. 30, 1935. 23814/36.

PROCESS FOR THE MANUFACTURE OF ZINC-SULPHIDE-CONTAINING PIGMENTS.—I. G. Farbenindustrie. Aug. 31, 1935. 23850/36.

MANUFACTURE OF CONDENSATION PRODUCTS.—Challenge Adhesives, Ltd. Aug. 30, 1935. 23860/36.

Specifications Accepted with Date of Application

MANUFACTURE OF ORGANIC ACID ANHYDRIDES.—H. E. Potts (Shawinigan Chemicals, Ltd.). May 18, 1935. 461,808.

MANUFACTURE OF OXIDISING OR REDUCING AGENTS or combined oxidising and reducing agents, more particularly intended for promoting metabolic changes in living organisms.—W. F. Koch. May 22, 1935. 461,879.

SUBSTITUTES FOR FATTY ALCOHOLS.—W. J. Tennant (Henkel and Cie, Ges.). May 22, 1935. 461,957.

PRODUCTION OF POLYHYDRIC ALCOHOL-POLYBASIC ACID RESIN.—I. Rosenblum. June 27, 1934. 461,742.

MANUFACTURE AND PRODUCTION OF CARBOXYLIC ACID AMIDES and nitrogenous condensation products.—G. W. Johnson (I. G. Farbenindustrie.) July 20, 1935. 461,883.

MANUFACTURE AND PRODUCTION OF AZO DYE-STUFFS.—G. W. Johnson (I. G. Farbenindustrie.) July 22, 1935. 461,884.

MANUFACTURE AND PRODUCTION OF POLYHYDROXY COMPOUNDS of the dibenzanthrone series.—G. W. Johnson (I. G. Farbenindustrie.) July 22, 1935. 461,885.

PREPARATION AND USE OF CATALYTIC BODIES.—C. Pleydell-Bouverie, and O. D. Lucas. July 25, 1935. 461,888.

REFINING OF MINERAL OILS.—Steel Bros. and Co., Ltd., and S. S. Bhatnagar. Aug. 19, 1935. 461,813.

PHOTOGRAPHIC DESENSITISERS.—W. W. Groves (I. G. Farbenindustrie.) Aug. 20, 1935. 461,890.

MANUFACTURE AND PRODUCTION OF AZO DYE-STUFFS.—G. W. Johnson (I. G. Farbenindustrie.) Aug. 22, 1935. 461,965.

MANUFACTURE OF 2:6-DIMETHYLNAPHTHALENE-1-SULPHONIC ACID.—W. W. Groves (I. G. Farbenindustrie.) Aug. 22, 1935. 461,894.

MANUFACTURE OF COMPOUNDS OF THE CYCLOPENTANO POLYHYDROPHENANTHRENE SERIES.—Schering-Kahlbaum, A.-G. Aug. 22, 1934. 461,895.

MANUFACTURE OF COMPOUNDS OF THE CYCLOPENTANO POLYHYDROPHENANTHRENE SERIES.—Schering-Kahlbaum, A.-G. Aug. 23, 1934. 461,896.

WETTING-AGENTS FOR ALKALI LYES.—Chemical Works, formerly Sandoz. Aug. 24, 1934. 461,747.

DYEING OF TEXTILES.—I. G. Farbenindustrie. Aug. 25, 1934. 461,752.

MANUFACTURE AND PRODUCTION OF TANNING AGENTS containing iron.—G. W. Johnson (I. G. Farbenindustrie.) Aug. 26, 1935. 462,026.

OXIDATION OF HYDROCARBONS.—G. W. Johnson (I. G. Farbenindustrie.) Aug. 26, 1935. 461,972.

METHACRYLIC ACID ESTERS OF POLYHYDRIC ALCOHOLS and their manufacture.—E. I. du Pont de Nemours and Co., and J. C. Woodhouse. Aug. 26, 1935. 461,979.

PRODUCTION OF SEMI-SOLUBLE AND DISPERSABLE CALCIUM PECTINATE.—General Foods Corporation. Aug. 28, 1934. 462,028.

PROCESS FOR THE MANUFACTURE OF ANTHRAQUINONE DERIVATIVES.—I. G. Farbenindustrie. Aug. 29, 1934. 461,998.

DELAY-ACTION DETONATORS AND FUZES and delay compositions for use therein.—C. E. Sosson, and Imperial Chemical Industries, Ltd. Aug. 29, 1935. 462,000.

SEPARATION OF VOLATILISED LIQUIDS FROM GASEOUS MIXTURES.—Distillers Co., Ltd., H. A. Auden, H. P. Staudinger, and H. M. Hutchinson. Sept. 7, 1935. 461,758.

PROCESS FOR OBTAINING ALIMENTARY SUBSTANCES FROM EARTH-NUTS and other edible oleaginous grains or seeds.—P. Ammann. Sept. 14, 1934. 461,760.

MANUFACTURE AND PRODUCTION OF CONDENSATION PRODUCTS.—G. W. Johnson (I. G. Farbenindustrie.) Oct. 4, 1935. 461,827.

MANUFACTURE OF THE LIQUIDS USED IN AIRCRAFT provided with propellers.—M. Vullierme. March 25, 1935. 461,846.

PRODUCTION OF METALLIC SULPHATES, and ammonium sulphite and sulphur or ammonium thiosulphate.—American Zinc, Lead, and Smelting Co. April 15, 1935. 461,849.

FATTY-OIL POLYMERS.—Standard Oil Development Co. Sept. 14, 1935. 461,853.

PROCESS FOR THE MANUFACTURE OF LAEVO-ASCORBIC ACID.—Hoffmann-La Roche and Co., A.-G. June 6, 1935. 461,790.

METHOD OF PRODUCING HYDROGEN PEROXIDE.—H. Schmidt. June 22, 1935. 461,792.

MANUFACTURE OF CHROMIUM HYDROXIDE GREEN.—G. Siegle and Co., Ges. Aug. 2, 1935. 461,199.

MANUFACTURE OF CHROMIUM HYDROXIDE GREEN.—G. Siegle and Co., Ges. Feb. 7, 1936. 461,800.

PROCESS OF CATALYTIC OXIDATION OF NAPHTHALENE.—C. Pleydell-Bouverie, and O. D. Lucas. July 25, 1935. 461,949.

PRODUCTION OF DIAMINOALCOHOLS OF THE AROMATIC SERIES.—Dr. J. Wiernik Chemische Fabriken and Co., A.-G. Aug. 5, 1936. 461,866.

PRODUCTION OF PHOSPHATIC FERTILISERS.—Rochling'sche Eisen-Und Stahlwerke Ges. March 28, 1936. 461,869.

PROCESSES FOR THE MANUFACTURE OF ACID ALKALI PYROPHOSPHATES.—Chemische Fabrik Budeenheim, A.-G. Nov. 2, 1935. 461,871.

MANUFACTURE OF CHRYSENE-CARBOXYLIC ACIDS.—I. G. Farbenindustrie. Aug. 18, 1934. 461,676.

MANUFACTURE OF POLYVINYLL DERIVATIVES containing nitrogen.—I. G. Farbenindustrie. Aug. 21, 1934. 461,635.

METHOD OF WASHING GASES and apparatus therefor.—I. G. Farbenindustrie. Aug. 22, 1934. 461,636.

PURIFICATION AND GRANULATION OF PENTAERYTHRITOL TETRANITRATE.—W. A. P. Challenor, and Imperial Chemical Industries, Ltd. Aug. 20, 1935. 461,641.

COMBUSTION TRAIN ELEMENTS AND FUZES for blasting and pyrotechnic and the like purposes.—J. S. B. Fleming, R. C. Payn, and Imperial Chemical Industries, Ltd. Aug. 21, 1935. 461,648.

PRODUCTION OF RESIN EMULSIONS.—Bakelite, Ltd. Aug. 22, 1934. 461,649.

PRODUCTION OF RESIN EMULSIONS.—Bakelite, Ltd. Aug. 22, 1934. 461,650.

TANNING HIDES AND PELTS with the aid of iron compounds.—G. W. Johnson (I. G. Farbenindustrie.) Aug. 26, 1935. 461,685.

MANUFACTURE AND PRODUCTION OF VINYL COMPOUNDS.—Coutts and Co., and F. Johnson (Legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie.) Aug. 27, 1935. (Addition to 438,281 and 451,444.) 461,357.

MANUFACTURE AND PRODUCTION OF THE TRANSPARENT PARTS OF METAL-VAPOUR LAMPS and the like.—I. G. Farbenindustrie. and G. W. Johnson. Sept. 2, 1935. (Addition to 400,742.) 461,570.

THERMAL CONVERSION OF HYDROCARBONS into valuable products.—Ruhrlchemie, A.-G. March 18, 1935. 461,366.

CINCHONA ALKALOID DERIVATIVES.—L. H. Cretcher, W. L. Nelson, C. L. Butler, and A. G. Renfrew. Nov. 27, 1935. 461,373.

PREPARATION OF OXYGENATED ALIPHATIC COMPOUNDS.—Carbide and Carbon Chemicals Corporation. Dec. 20, 1934. 461,662.

PRODUCTION OF HYDROGEN PEROXIDE.—L. Mellersh-Jackson (Mathieson Alkali Works). Feb. 5, 1936. 461,589.

PRODUCTION OF ORGANIC FERTILISERS having fungicidal, germicidal, and insecticidal properties.—V. Margules (née Abeles), and J. Trummer. Feb. 24, 1936. 461,464.

PROCESSES FOR THE MANUFACTURE OF FOILS or FILMS of cellulose tri-acetate.—Deutsche Gold- Und Silberscheideanstalt Vorm. Roessler. March 6, 1935. 461,593.

VAPOUR PHASE CRACKING OF HYDROCARBONS.—A. Cambron, and C. H. Bayley. March 17, 1936. 461,392.

PRODUCTION OF A GAS OF DEFINITE STOICHIOMETRIC COMPOSITION by the carbonisation of fuels.—Didier-Werke, A.-G. July 22, 1935. 461,402.

PROCESSES FOR THE MANUFACTURE OF CAUSTIC ALKALIES.—H. W. K. Jennings (Consolidirte Alkaliwerke). April 29, 1936. 461,597.

PROCESS FOR MAKING STABLE PHOSPHOROUS-CONTAINING COD-LIVER OIL EMULSIONS.—J. A. Benckiser Ges. Chemische Fabrik, and F. Draisbach. July 20, 1935. 461,535.

PRODUCTION OF FISH MEAL AND OIL.—L. T. Hopkinson. May 10, 1935. 461,411.

PROCESS FOR STABILISING LEAD TETRAETHYL and anti-knock mixtures containing same.—I. G. Farbenindustrie. Oct. 26, 1935. 461,604.

Applications for Patents

MANUFACTURE OF SULFANIC ACID AMIDES.—H. J. W. France. (Hoffmann-La Roche and Co.) 5409.

PRODUCTION OF NITRATES, ETC. FROM METALLIC CHLORIDES.—H. Frischer. 5145.

MANUFACTURE OF ALDEHYDES of the di- and poly-arylether series.—J. R. Geigy, A.-G. (Germany, Feb. 29, '36.) 5550.

MANUFACTURE OF COMPOUNDS OF DIMETHYLBENZOTHIOPHENE.—I. Grossberg. (Austria, March 30, '36.) 5297.

DYEING CELLULOSE FIBROUS MATERIALS.—W. W. Groves (I. G. Farbenindustrie.) Sept. 18, '35. 4918.

MANUFACTURE OF AZO DYESTUFFS.—W. W. Groves (I. G. Farbenindustrie.) 5415.

PREPARATION OF TERPENE ETHERS.—Hercules Powder Co. (United States, March 7, '36.) 5482.

MANUFACTURE OF 3,4-DICYANODIPHENYL.—I. G. Farbenindustrie. (Germany, Feb. 20, '36.) 4893.

MANUFACTURE OF 1¹-CHLORO-1-METHYL-3-NITRONAPHTHALENE.—I. G. Farbenindustrie. (Germany, April 3, '36.) 5025.

MANUFACTURE OF TANNING-AGENTS.—I. G. Farbenindustrie, and W. W. Groves. 5142.

MANUFACTURE OF WATER-SOLUBLE CONDENSATION PRODUCTS of aromatic hydrocarbons.—I. G. Farbenindustrie. (Germany, Feb. 21, '36.) 5253.

MANUFACTURE OF CHLORINATED RUBBER PRODUCTS.—Imperial Chemical Industries, Ltd., J. G. Moore, and L. T. Dod. 5083.

OXIDATION OF STEROLS.—Imperial Chemical Industries, Ltd., and J. R. Wyles. 5084.

MANUFACTURE OF ORGANIC ACIDS, ETC.—Imperial Chemical Industries, and F. O. Leicester. 5564.

STABILISING RESIDUES OF DESTRUCTIVE HYDROGENATION OF COALS.—G. W. Johnson (I. G. Farbenindustrie.) 4924.

MANUFACTURE OF SYNTHETIC RESINS.—G. W. Johnson (I. G. Farbenindustrie.) 5002.

MANUFACTURE OF UNSATURATED HYDROCARBONS.—G. W. Johnson (I. G. Farbenindustrie.) 5124.

MANUFACTURE OF AZO DYESTUFFS.—G. W. Johnson (I. G. Farbenindustrie.) 5556.

MANUFACTURE OF OXIDISING, ETC. AGENTS.—W. F. Koch. May 22, '36. 4890.

MANUFACTURE OF NITROGEN CHLORINE COMPOUNDS.—Naamlooze Vennootschap Industrie Maatschappij voorheen Noury and Van der Lande. (Holland, Feb. 28, '36.) 5475.

PREPARATION OF BLEACHING, ETC. AGENTS.—Naamlooze Vennootschap Industrie Maatschappij voorheen Noury and Van der Lande. (Holland, Feb. 28, '36.) 5477.

HYDROGENATION OF POLYMERISATION PRODUCTS of unsaturated hydrocarbons.—H. E. Potts (International Hydrogenation Patents Co.) 5360.

PRODUCTION OF MALT ENZYMES.—Protex Ges. (Switzerland, March 4, '36.) 5587.

MANUFACTURE OF RUBBER CHLORIDE COMPOSITIONS.—Raolin Corporation. (United States, March 17, '36.) 5314, 5315, 5316.

MANUFACTURE OF COMPOUNDS OF ETIO-CHOLANE SERIES.—Schering-Kahlbaum, A.-G. (Germany, March 2, '36.) 5289.

MANUFACTURE OF SUPERPHOSPHATE FERTILISERS, ETC.—R. A. Smith (Facerform Corporation). 5015.

MANUFACTURE OF ANTHRAQUINONE DERIVATIVES.—Soc. of Chemical Industry in Basle. 5020, 5021.

PREPARATION OF SUSPENSIONS OF TITANIUM PIGMENTS.—W. J. Tennant (Titan Co.). 5262.

MANUFACTURE OF CONCENTRATED GAS LIQUOR.—W. L. Burns, P. Parrish and W. T. Kitching. 6105.

MANUFACTURE OF WATER-SOLUBLE DERIVATIVES OF CYCLOPENTANO-PERHYDROPHENANTHRENES.—A. Carpmael (I. G. Farbenindustrie.) 5686.

PREPARATION OF POLYDROXY LEUKO DERIVATIVES OF TRIPHENYL-METHANE.—Dr. Kereszty and Dr. Wolf, Chinoine Gyogyszer es Vegyeszeti Termekek Gyara reszvenytarsasag. (Hungary, March 4, '36.) 6108.

PRODUCTION OF CERAMIC PIGMENTS.—Deutsche Gold-und Silber-Scheideanstalt vorm. Roessler. (Germany, March 2, '36.) 6241.

PREPARATION OF CELLULOSE ETHERS.—Dow Chemical Co. (United States, March 6, '36.) 6079.

PRODUCTION OF UREA-ALDEHYDE SYNTHETIC RESINS.—E. I. du Pont de Nemours and Co., and H. S. Rothrock. 5892.

MANUFACTURE OF ORGANIC MERCURY COMPOUNDS.—Fahlberg-List, A.-G. Chemische Fabriken. (Germany, April 24, '36.) 6331.

PREPARATION OF HALOGEN-SUBSTITUTED FATTY ACID COMPOUNDS.—J. P. Fraser. 5828.

MANUFACTURE OF DISAZO-DYESTUFFS.—J. R. Geigy, A.-G. (Germany, May 8, '36.) 6229.

MANUFACTURE OF AROMATIC CARBOXYLIC ACID FLUORIDES.—W. W. Groves (I. G. Farbenindustrie.) 6060.

MANUFACTURE OF PRODUCTS CONTAINING NITROGEN and sulphur and their application.—W. W. Groves (I. G. Farbenindustrie.) 6328.

PRODUCTION OF BISULPHITE SOLUTIONS.—G. Haglund. (Germany, March 3, '36.) 5994.

MANUFACTURE OF COMPOUNDS of the azole series.—I. G. Farbenindustrie. (Germany, Feb. 28, '36.) 5713.

MANUFACTURE OF PIGMENT DYESTUFFS OF PHTHALOCYANINE SERIES.—I. G. Farbenindustrie. (Oct. 16, '36.) 5848.

MANUFACTURE OF NEW RESINOUS CONDENSATION PRODUCTS.—I. G. Farbenindustrie. (Germany, Feb. 29, '36.) 6056.

MANUFACTURE OF NEW RESINOUS CONDENSATION PRODUCTS.—I. G. Farbenindustrie. (Germany, Feb. 29, '36.) (Cognate with 6056.) 6057.

REMOVING MAGNESIUM FROM ALUMINIUM ALLOYS.—I. G. Farbenindustrie. (Germany, April 30, '36.) 6106.

MANUFACTURE OF WETTING, ETC., AGENTS.—I. G. Farbenindustrie. 6137.

Chemical and Allied Stocks and Shares

NO expansion of business has been reported in the stock and share markets since the commencements of the new Stock Exchange account on Monday. A growing disposition to await the Budget and the approach of the Easter holidays are the main factors influencing sentiment. The lower share values are a reflection of surrounding market conditions and do not necessarily indicate any less confident views regarding the prospects of the companies concerned. Distillers have been a bright feature, with a recovery on the week from 106s. 6d. to 112s. 9d. in response to a more general realisation of the good earning capacity of the company and the scope for further expansion of the industrial alcohol side of the business. Imperial Chemical have again been reactionary and are 38s. 7½d. at the time of writing, compared with 39s. 4½d. a week ago. The market continues to expect that the forthcoming announcement will show the maintenance of the dividend at 8 per cent. Cooper, McDougall and Robertson were steady around 37s., aided by confirmation of expectations of a larger dividend. Fison, Packard & Prentice were unchanged at 40s., and Imperial Smelting continued to hold their recent improvement, it being pointed out that the company has investments in the Burma Corporation and other base metal mines which are expected to yield a larger income.

Unilever were firm around 42s. 3d., awaiting the results, and there was again considerable business in United Molasses, which have remained around 30s. on favourable views of dividend prospects. United Premier Oil & Cake remained around 10s. 7½d. awaiting the results. British Oil and Cake Mills preferred ordinary shares were lower at 46s. 6d., at which they offer an apparently generous yield. United Glass Bottle were firm on the full report and larger dividend, and on the belief that the deal with the Distillers Co. is likely to make for a further good increase in earning capacity. Several other shares of glass companies were more prominent, including Canning Town Glass (the results are im-

minent) and John M. Newton, which it is also expected in the market will pay a larger dividend. Lancashire Safety Glass were in request on reports that the company is actively employed, and there was further buying of British Indestructo Glass on expectations of a good final dividend and the possibility that shareholders may have the offer of additional shares on favourable terms. Triplex Safety Glass, after declining further, showed a steadier tendency and are now 66s. 3d.

Turner and Newall and British Oxygen did not keep best prices, but the market is continuing to take the view that the forthcoming results of the latter company are likely to show a further good advance in profits, together with a satisfactory increase in dividend, and possibly an issue of shares on bonus terms. Salt Union were not affected by the full report, having remained at 40s. at the time of writing. Demand was in evidence for International Combustion on any reaction in price, favourable views being current as to the scope for further profitable expansion of the business. Boots Pure Drug have been affected by fears of possible further taxation of proprietary medicines. Whilst this might affect sales at the company's shops, it is not generally expected that these fears will be realised. Greek Chemicals Holdings were more active around 9s. 6d., and Monsanto Chemicals 5½ per cent. preference were firm at 22s. 9d. in view of the good cover for their dividend requirements, arising from the increased profits shown by the recently issued results. Pinchin Johnson, International Paint and Indestructible Paint have been subject to profit-taking following the recent excellent dividend announcements.

Oil shares were reactionary owing to general market conditions, but favourable dividend estimates remain current in the market. It is generally assumed that "Shell" Transport will be able to raise its dividend to 20 per cent., tax free, despite the larger capital resulting from the share bonus.

Weekly Prices of British Chemical Products

HERE are no price changes to report in the London markets for general heavy chemicals, tar products, pharmaceutical and photographic chemicals, perfumery chemicals, essential oils, and intermediates. In the rubber chemicals section the prices of cadmium sulphide and vermillion have increased during the week. There have also been advances in the prices of most of the wood distillation products.

MANCHESTER.—The extremely wide fluctuations in non-ferrous metal prices from day to day continue to exercise a very unsettling influence on lead and copper compounds and other sections of the chemical market. With regard to the general run of heavy chemicals, Manchester traders during the past week have dealt with a moderate volume of new inquiry, though actual new business has not been of very great consequence. There has, however, been no falling off in the rate at which the soda products generally, as well as certain potash materials and other chemicals are being called for against contracts, and although a seasonal contraction is looked for during the next couple of weeks the outlook is satisfactory. With the exception of pitch the by-products

market is firm, with a particularly strong tone reported in the case of carbolic acid, both crude and crystals, cresylic acid, and the naphthalenes.

GLASGOW.—There has been a steady day to day demand for chemicals for home trade during the week, but export business has again been very quiet. Prices generally continue very firm at about previous figures; lead and copper products being again dearer. Red and white lead have been advanced £3 per ton during the week. There has been a generally firm tone on the market for coal tar by-products. Latest quotations show further advances in carbolic and cresylic acids, with available supplies strictly limited. There has also been an advance of 4d. per gal. in motor benzole, and sellers have been holding out for fully 1d. per gal. more in various grades of refined naphthas on offer. Creosote and washed oils are in steady demand, and fair contract deliveries have commenced for both home and export. Pitch on the whole continues dull, although in certain quarters the stock position has been considerably relieved.

General Chemicals

ACETONE.—£45 to £47 per ton.

ACID, ACETIC.—Tech., 80%, £30 5s. to £32 5s. per ton; pure 80%, £30 5s.; tech., 40%, £15 12s. 6d. to £18 12s. 6d.; tech., 60%, £23 10s. to £25 10s. MANCHESTER: 80%, commercial, £30 5s.; tech. glacial, £42 to £46.

ACID, BORIC.—Commercial granulated, £27 per ton; crystal, £28; powdered, £29; in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. GLASGOW: Crystals, in 1-cwt. bags, £28; powdered, in 1-cwt. bags, £29.

ACID, CHROMIC.—9d. per lb., less 2½%; d/d U.K.

ACID, CITRIC.—1s. per lb. MANCHESTER: 11½d. SCOTLAND: B.P. crystals, 1s. per lb., less 5%.

ACID, FORMIC.—85%, in carboys, ton lots, £42 to £47 per ton.

ACID, HYDROCHLORIC.—Spot, 5s. to 7s. 6d. carboy d/d according to purity, strength and locality.

ACID, LACTIC.—LANCASHIRE: Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £50: pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £55; edible, 50% by vol., £41. One-ton lots ex works, barrels free.

ACID, NITRIC.—80° Tw. spot, £18 to £25 per ton makers' works.

ACID, OXALIC.—£48 15s. to £57 10s. per ton, according to packages and position. GLASGOW: £2 9s. per cwt. in casks. MANCHESTER: £49 to £54 per ton ex store.

ACID, SULPHURIC.—168° Tw., £4 5s. to £4 15s. per ton; 140° Tw., arsenic-free, £2 10s. to £3 5s.; 140° Tw., arsenious, £2 10s.

ACID, TARTARIC.—1s. 0½d. per lb. less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 11½d. to 1s. per lb.

ALUM.—Loose lump, £8 7s. 6d. per ton d/d; GLASGOW: Ground, £10 2s. 6d. per ton; lump, £9 12s. 6d.

ALUMINIUM SULPHATE.—£7 per ton d/d Lancs.; GLASGOW: £7 to £8 ex store.

AMMONIA, ANHYDROUS.—Spot, 10d. per lb. d/d in cylinders. SCOTLAND: 10d. to 1s. containers extra and returnable.

AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.

AMMONIUM BICHROMATE.—8d. per lb. d/d U.K.

AMMONIUM CARBONATE.—£20 per ton d/d in 5 cwt. casks.

AMMONIUM CHLORIDE.—LONDON: Fine white crystals, £16 10s. (See also Salammoniac.)

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammoniac.)

ANTIMONY OXIDE.—£55 10s. per ton.

ARSENIC.—LONDON: £13 10s. per ton c.i.f. main U.K. ports for imported material; Cornish nominal, £22 10s. f.o.r. mines. SCOTLAND: White powdered, £17 ex store. MANCHESTER: White powdered Cornish, £18, ex store.

BARIUM CHLORIDE.—£10 per ton. GLASGOW: £11 5s. per ton.

BISULPHITE OF LIME.—£6 10s. per ton f.o.r. London.

BLEACHING POWDER.—Spot, 35/37%. £8 15s. per ton in casks, special terms for contracts. SCOTLAND: £9.

BORAX COMMERCIAL.—Granulated, £14 10s. per ton; crystal £15 10s.; powdered, £16; packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. GLASGOW: Granulated, £14 10s. per ton in 1-cwt. bags, carriage paid.

CALCIUM CHLORIDE.—Solid 70/75% spot, £5 5s. per ton d/d station in drums. GLASGOW: 70/75% solid, £5 10s. per ton net ex store.

CHROMETAN.—Crystals, 2½d. per lb.; liquor, £19 10s. per ton d/d.

CREAM OF TARTAR.—£3 19s. per cwt. less 2½%. GLASGOW: £4 4s. net.

FORMALDEHYDE.—£22 10s. per ton.

GLYCERINE.—Chemically pure, double distilled, 1.260 s.g., in tins, £5 7s. 6d. to £6 7s. 6d. per cwt. according to quantity; in drums, £5 to £5 13s. 6d.

IODINE.—Resublimed B.P., 5s. 1d. per lb.

LEAD ACETATE.—LONDON: White, £35 10s. per ton; brown, £35. GLASGOW: White crystals, £34 to £35; brown, £1 per ton less. MANCHESTER: White, £38 10s.; brown, £37 10s.

LEAD NITRATE.—£39 per ton.

LEAD, RED.—SCOTLAND: £48 10s. per ton less 2½%, carriage paid, for 2-ton lots.

LEAD (WHITE SUGAR OF).—GLASGOW: £37 per ton net, ex store.

MAGNESITE.—SCOTLAND: Ground calcined, £9 per ton, ex store.

MAGNESIUM CHLORINE.—SCOTLAND: £7 10s. per ton.

MAGNESIUM SULPHATE.—Commercial, £5 per ton, ex wharf.

MERCURY.—Ammoniated B.P. (white precip.), lump, 5s. 11d. per lb.; powder B.P., 6s. 1d.; bichloride B.P. (corros. sub.) 5s. 2d.; powder B.P. 4s. 10d.; chloride B.P. (calomel), 5s. 11d.; red oxide cryst. (red precip.), 7s.; levig. 6s. 6d.; yellow oxide B.P. 6s. 4d.; persulphate white B.P.C., 6s. 1d.; sulphide black (hyd. sulph. cum sulph. 50%), 6s. For quantities under 112 lb., 1d. extra.

METHYLATED SPIRIT.—61 O.P. industrial, 1s. 5d. to 2s. per gal.; pyridinised industrial, 1s. 7d. to 2s. 2d.; mineralised, 2s. 6d. to 3s. Spirit 64 O.P. is 1d. more in all cases and the range of prices is according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

PARAFFIN WAX.—SCOTLAND: 3½d. per lb.

PHENOL.—6½d. to 7½d. per lb.

POTASH, CAUSTIC.—LONDON: £42 per ton. MANCHESTER: £40.

POTASSIUM BICHROMATE.—SCOTLAND: 5d. per lb., less 5%, carriage paid.

POTASSIUM CHLORATE.—£36 7s. 6d. per ton. GLASGOW: 4½d. per lb. MANCHESTER: £38 per ton.

POTASSIUM IODIDE.—B.P. 4s. 3d. per lb.

POTASSIUM NITRATE.—£27 per ton. GLASGOW: Refined granulated, £29 per ton c.i.f. U.K. ports. Spot, £30 per ton ex store.

POTASSIUM PERMANGANATE.—LONDON: 9½d. per lb. SCOTLAND: B.P. Crystals, 9½d. MANCHESTER: B.P. 10½d. to 11½d.

POTASSIUM PRUSSATE.—6½d. per lb. SCOTLAND: 7d. net, in casks, ex store. MANCHESTER: Yellow, 6½d. to 6d.

SALAMMONIAC.—First lump spot, £41 17s. 6d. per ton d/d in barrels. GLASGOW: Large crystals, in casks, £38.

SALT CAKE.—Unground, spot, £3 16s. 6d. per ton.

SODA ASH.—58% spot, £5 12s. 6d. per ton f.o.r. in bags.

SODA, CAUSTIC.—Solid, 76/77% spot, £12 10s. per ton d/d station. SCOTLAND: Powdered 98/99%, £17 10s. in drums, £18 5s. in casks, Solid 76/77%, £14 12s. 6d. in drums; 76/73%, £14 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts 10s. per ton less.

SODA CRYSTALS.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

SODIUM ACETATE.—£18 per ton net ex store. GLASGOW: £18 10s. per ton net ex store.

SODIUM BICARBONATE.—Refined spot, £10 10s. per ton d/d station in bags. GLASGOW: £12 15s. per ton in 1-cwt. kegs, £11 per ton in 2-cwt. bags. MANCHESTER: £10 10s.

SODIUM BICHROMATE.—Crystals cake and powder 4d. per lb. net d/d U.K. discount 5%. MANCHESTER: 4d. per lb. GLASGOW: 4d., less 5% carriage paid.

SODIUM BISULPHITE POWDER.—60/62%, £20 per ton d/d 1 cwt. iron drums for home trade.

SODIUM CARBONATE, MONOHYDRATE.—£15 per ton d/d in minimum ton lots in 2 cwt. free bags.

SODIUM CHLORATE.—£26 10s. to £30 per ton. GLASGOW: £1 10s. per cwt.

SODIUM CHROMATE.—4d. per lb. d/d U.K.

SODIUM HYPOSULPHATE.—Commercial, 2 ton lots d/d, £10 5s. per ton; photographic, £14 5s. MANCHESTER: Commercial, £10; photographic, £14 10s.

SODIUM METASILICATE.—£14 per ton, d/d U.K. in cwt. bags.

SODIUM NITRATE.—Refined, £7 15s. per ton for 6-ton lots d/d. **SODIUM NITRITE.**—£18 5s. per ton for ton lots. **SODIUM PERBORATE.**—10%, 9½d. per lb. d/d in 1-cwt. drums. **SODIUM PHOSPHATE.**—£13 per ton. **SODIUM PRUSSIATE.**—4d. per lb. for ton lots. **GLASGOW**: 5d. to 5½d. ex store. **MANCHESTER**: 4½d. to 4½d. **SODIUM SILICATE.**—£9 10s. per ton. **SODIUM SULPHATE (GLAUBER SALTS).**—£3 per ton d/d. **SODIUM SULPHATE (SALT CAKE).**—Unground spot, £3 12s. 6d. per ton d/d station in bulk. **SCOTLAND**: Ground quality, £3 5s. per ton d/d. **MANCHESTER**: £3 5s. **SODIUM SULPHIDE.**—Solid 60/62%, Spot, £11 5s. per ton d/d in drums; crystals 30/32%, £8 15s. per ton d/d in casks. **MANCHESTER**: Concentrated solid, 60/62%, £11; commercial, 28. **SODIUM SULPHITE.**—Pea crystals, spot, £13 5s. per ton d/d station in kegs. Commercial spot, £8 15s. d/d station in bags. **SULPHATE OF COPPER.**—£20 per ton, less 2%, in casks. **MANCHESTER**: £25 10s. per ton f.o.b. **SCOTLAND**: £26 10s. per ton less 5%, Liverpool, in casks. **SULPHUR PRECIP.**—B.P., £55 to £60 per ton according to quantity. Commercial, £50 to £55. **ZINC SULPHATE.**—Crystals, £9 per ton, f.o.r., in bags.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 1d. per lb., according to quality. Crimson, 1s. 5½d. to 1s. 7d. per lb., according to quality. **ARSENIC SULPHIDE.**—Yellow, 1s. 5d. to 1s. 7d. per lb. **BARYTES.**—£6 to £7 10s. per ton, according to quality. **CADMIUM SULPHIDE.**—6s. to 6s. 3d. per lb. **CARBON BISULPHIDE.**—£31 to £33 per ton, according to quantity, drums extra. **CARBON BLACK.**—3 11/16d. to 4 13/16d. per lb., ex wharf. **CARBON TETRACHLORIDE.**—£41 to £46 per ton, according to quantity, drums extra. **CHROMIUM OXIDE.**—Green, 1s. 2d. per lb. **DIPHENYLGUANIDINE.**—2s. 2d. per lb. **INDIA-RUBBER SUBSTITUTES.**—White, 4½d. to 5d. per lb.; dark, 3d. to 4½d. per lb. **LAMP BLACK.**—£22 to £23 per ton d/d London; vegetable black, £28 to £48. **LEAD HYPOSULPHITE.**—9d. per lb. **LITHOPONE.**—30%, £16 10s. to £17 5s. per ton. **SULPHUR.**—£9 to £9 5s. per ton. **SULPHUR PRECIP.** B.P., £55 to £60 per ton. **SULPHUR PRECIP. COMM.**, £50 to £55 per ton. **SULPHUR CHLORIDE.**—5d. to 7d. per lb., according to quantity. **VERMILION.**—Pale, or deep, 5s. 3d. per lb., 1-cwt. lots. **ZINC SULPHIDE.**—10d. to 11d. per lb., according to quality.

Nitrogen Fertilisers

SULPHATE OF AMMONIA.—Neutral quality, basis 20.6 per cent. nitrogen, delivered in 6-ton lots to farmer's nearest station, March to June, £7 5s. per ton. **CALCIUM CYANAMIDE.**—March, £7 3s. 9d. per ton; April to June, £7 5s. per ton, carriage paid to any railway station in Great Britain in lots of four tons and over. **NITRO-CHALK.**—£7 5s. per ton for delivery to end of June. **NITRATE OF SODA.**—£7 12s. 6d. per ton for delivery up to end of June. **AMMONIUM PHOSPHATE FERTILISERS.**—£10 5s. to £13 15s. per ton for delivery up to end of June, delivered in 6-ton lots to farmer's nearest station.

Coal Tar Products

ACID, CRESYLIC.—97/99%, 4s. 2d. to 4s. 3d. per gal.; 99/100%, 4s. 6d. to 5s. per gal., according to specification; pale 99%, 4s. 4d. to 4s. 5d.; dark, 3s. 8d. to 3s. 10d. **GLASGOW**: Pale, 99/100%, 4s. to 4s. 6d. per gal.; pale 97/99%, 3s. 9d. to 4s.; dark, 97/99%, 3s. 4d. to 3s. 8d.; high boiling acids, 2s. 3d. to 2s. 6d. American specification, 3s. 6d. to 4s. **MANCHESTER**: Pale, 99/100%, 4s. 8d. **ACID, CARBOLIC.**—Crystals, 6½d. to 7½d. per lb.; crude, 60's, 2s. 11d. to 3s. 2d. per gal. **MANCHESTER**: Crystals, 7d. per lb.; crude 3s. 4d. per gal. **GLASGOW**: Crude, 60's, 3s. 2d. to 3s. 8d. per gal.; distilled, 60's, 3s. 8d. to 4s. **BENZOL.**—At works, crude, 9½d. to 10d. per gal.; standard motor 1s. 3d. to 1s. 3½d.; 90%, 1s. 4d. to 1s. 4½d.; pure, 1s. 8d. to 1s. 8½d. **LONDON**: Motor, 1s. 3½d. **GLASGOW**: Crude, 9½d. to 10½d. per gal.; motor, 1s. 4d. to 1s. 5d. **CREOSOTE.**—B.S.I. Specification standard, 5½d. to 6d. per gal. f.o.r. Home, 3½d. d/d. **LONDON**: 4½d. f.o.r. North: 5d. London. **MANCHESTER**: 5d. to 6d. **GLASGOW**: B.S.I. Specification 5½d. to 5½d. per gal.; washed oil, 4½d. to 5½d.; lower sp. gr. oils, 5d. to 5½d. **NAPHTHA.**—Solvent, 90/160%, 1s. 6½d. to 1s. 7½d. per gal.; 95/160%, 1s. 7d. to 1s. 8d.; 90/190%, 1s. 1½d. to 1s. 2½d. **LONDON**: Solvent, 1s. 3½d. to 1s. 4d.; heavy, 11d. to 1s. 0½d. f.o.r. **GLASGOW**: Crude, 6d. to 6½d. per gal.; 90% 160, 1s. 6d. to 1s. 7d. 90% 190, 1s. 1d. to 1s. 2d.

NAPHTHALENE.—Crude, whizzed or hot pressed, £11 10s. to £12 10s. per ton; purified crystals, £18 to £20 per ton in 2-cwt. bags. **LONDON**: Fire lighter quality, £5 to £5 10s. per ton; crystals, £27 to £27 10s. **GLASGOW**: Fire lighter, crude, £6 to £7 per ton (bags free). **MANCHESTER**: Refined £24 per ton f.o.b.

PYRIDINE.—90/140%, 8s. 6d. to 9s. 6d. per gal.; 90/180, 2s. 6d. to 3s. **GLASGOW**: 90% 140, 9s. to 10s. per gal.; 90% 160, 7s. to 8s.; 90% 180, 2s. 6d.

TOLUOLE.—90%, 2s. per gal.; pure, 2s. 5d. **GLASGOW**: 90%, 120, 1s. 10d. to 1s. 11d. per gal.

PITCH.—Medium, soft, 35s. per ton, in bulk at makers' works. **MANCHESTER**: 34s. f.o.b., East Coast. **GLASGOW**: f.o.b. Glasgow, 28s. 6d. to 35s. per ton; in bulk for home trade, 32s. 6d.

XYLOL.—Commercial, 2s. 2d. per gal.; pure, 2s. 4d. **GLASGOW**: Commercial, 1s. 11d. to 2s. per gal.

Wood Distillation Products

ACETATE OF LIME.—Brown, £8 10s. to £9 per ton; grey, £10 10s. to £11 10s. Liquor, brown, 30° Tw., 6d. to 8d. per gal.

MANCHESTER: Brown, £9 10s.; grey, £11 10s.

CHARCOAL.—£5 15s. to £11 per ton, according to grade and locality.

METHYL ACETONE.—40-50%, £42 to £45 per ton.

WOOD CREOSOTE.—Unrefined 6d. to 1s. 6d. per gal., according to boiling range.

WOOD, NAPHTHA, MISCELLY.—2s. 9d. to 3s. 3d. per gal.; solvent, 3s. 6d. to 3s. 9d. per gal.

WOOD TAR.—£2 10s. to £4 per ton.

Intermediates and Dyes

ACID, BENZOIC, 1914 B.P. (ex toluol).—1s. 9½d. per lb. d/d buyer's works.

ACID, GAMMA.—Spot, 4s. per lb. 100% d/d buyer's works.

ACID, H.—Spot, 2s. 4d. per lb. 100% d/d buyer's works.

ACID NAPHTHONIC.—1s. 8d. per lb.

ACID, NEVILLE AND WINTHER.—Spot, 3s. per lb. 100%.

ACID, SULPHANILIC.—Spot, 8d. per lb. 100%, d/d buyer's works.

ANILINE OIL.—Spot, 8d. per lb., drums extra, d/d buyer's works.

ANILINE SALTS.—Spot, 8d. per lb. d/d buyer's works, casks free.

BENZIDINE, HCl.—2s. 5d. per lb., 100% as base, in casks.

m-CRESOL 98/100%, 1s. 8d. to 1s. 9d. per lb. in ton lots.

o-CRESOL 30/31° C.—6½d. to 7½d. per lb. in 1-ton lots.

p-CRESOL 34-5° C.—1s. 7d. to 1s. 8d. per lb. in ton lots.

DICHLORANILINE.—2s. 3d. per lb.

DIMETHYLANILINE.—Spot, 1s. 6d. per lb., package extra.

DINITROBENZENE.—7½d. per lb.

DINITROCHLORBENZENE, SOLID.—£72 per ton.

DINITROTOLUENE.—48/50° C., 8½d. per lb.; 66/68° C., 10d.

DIPHENYLAMINE.—Spot, 2s. per lb., d/d buyer's works.

α-NAPHTHOL.—Spot, 2s. 4d. per lb., d/d buyer's works

β-NAPHTHOL.—In bags, £88 15s. per ton; in casks, £89 15s.

α-NAPHTHYLAMINE.—Lumps, 1s. per lb.; ground, 1s. 0½d. in casks.

β-NAPHTHYLAMINE.—Spot, 2s. 9d. per lb., d/d buyer's works in casks.

o-NITRANILINE.—3s. 11d. per lb.

n-NITRANILINE.—Spot, 2s. 7d. per lb., d/d buyer's works.

p-NITRANILINE.—Spot, 1s. 8d. to 2s. 1d. per lb. d/d buyer's works.

NITROBENZENE.—Spot, 4½d. to 5d. per lb., in 90-gal. drums, drums extra. 1-ton lots d/d buyer's works.

NITRONAPHTHENE.—9d. per lb.; P.G., 1s. 0½d. per lb.

SODIUM NAPHTHIONATE.—Spot, 1s. 9d. per lb., 100% d/d buyer's works.

o-TOLUIDINE.—10½d. per lb., in 8/10-cwt. drums, drums extra.

p-TOLUIDINE.—1s. 10½d. per lb., in casks.

m-XYLIDINE ACETATE.—4s. 3d. per lb., 100%.

Latest Oil Prices

LONDON, March 17.—**LINSEED OIL** was very firm. Spot, £31 per ton (small quantities), April, £28 12s. 6d.; May-Aug., £28 17s. 6d.; Sept.-Dec., £29 5s., naked. **SOYA BEAN OIL** was steady. **Oriental** (bulk), afloat, Rotterdam, £28 10s. per ton. **RAPE OIL** was steady. **Crude** extracted, £35 10s. per ton; technical refined £36 10s., naked, ex wharf. **COTTON OIL** was firm. **Egyptian** crude, £29 10s. per ton; refined common edible, £33 10s.; deodorised, £35 10s., naked, ex mill (small lots, £1 10s. extra). **TURPENTINE** was quiet. **American** (spot), 40s. 3d. per cwt.

HULL.—**LINSEED OIL**, spot, quoted £28 12s. 6d. per ton; March and April, £28 2s. 6d.; May-Aug., £28 10s.; Sept.-Dec., £28 15s. **COTTON OIL**, Egyptian, crude, spot, £30; edible, refined, spot, £32 15s.; technical, spot, £32 15s.; deodorised, £34 15s., naked. **PALM KERNEL OIL**, crude, f.m.q., spot, £33 10s., naked. **GROUNDNUT OIL**, extracted, spot, £23; deodorised, £36. **RAPE OIL**, extracted, spot, £34 10s.; refined, £35 10s. **SOYA OIL**, extracted, spot, £32 10s.; deodorised, £35 10s. per ton. **COD OIL**, f.o.r. or f.a.s., 27s. 6d. per cwt., in barrels. **CASTOR OIL**, pharmaceutical, 45s. 6d.; first, 40s. 6d.; second, 38s. 6d. **TURPENTINE**, American, spot, 42s. 6d. per cwt.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

(NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BITUMINOUS COMPOSITIONS, LTD., Grimsby. (M., 20/3/37.) March 6. £17,000 debenture, to F. W. Gough, Grimsby; general charge. *£17,023. January 20, 1937.

RILEY'S CHEMICAL AND COLOURS, LTD., Clayton-le-Moors. (M., 20/3/37.) March 5, charge, to District Bank, Ltd., securing all moneys due or to become due to the Bank; charged on Clayton Mill and 411 and 413 Whalley Road, Clayton-le-Moors. Nil. October 22, 1936.

Satisfactions

BITUMINOUS COMPOSITIONS, LTD., Grimsby. (M.S., 20/3/37.) Satisfaction March 6 of debenture registered August 5, 1931.

ULA KLANG RUBBER CO., LTD., London, E.C. (M.S., 20/3/37.) Satisfaction March 5, of debenture registered January 12, 1926.

Companies Winding-up Voluntarily

ANGLO-VENEZUELAN OIL TRUST, LTD. (C.W.U.V., 20/3/37.) By extraordinary resolution, March 8, 1937. Mr. James William Creasser, of River Plate House, Finsbury Circus, London, E.C.2, appointed liquidator.

Company News

Doulton and Co.—A dividend of 7½ per cent., less tax (nil), has been declared for 1936.

British Drug Houses.—The usual quarterly dividend of 1½ per cent. on preference shares will be paid on March 31.

Imperial Smelting Corporation.—The usual half-yearly dividend on the 6½ per cent. preference shares for the half-year ended December 31, 1936, payable April 1, less tax, is announced.

Indestructible Paint.—A final dividend on the £143,000 ordinary capital for 1936 of 16½ per cent., making 22½ per cent., payable on April 30 next, is announced. This compares with 20 per cent. in the two preceding years.

British Aluminium Co.—A striking increase in profits is revealed in the preliminary statement for 1936. Net profits are up by £102,079, to £348,931, after again providing £50,000 for depreciation. The dividend on the £2,000,000 ordinary capital is stepped up by 2½ per cent., to 10 per cent., the best since a similar distribution was made for 1930. Allocations to reserve are resumed with a transfer of £50,000, which brings this fund up to £1,250,000, while the carry-forward is raised by £8,931 to £71,159.

United Turkey Red.—The report for the year ended December 31 last, after providing for all charges, including maintenance and depreciation, shows a loss of £48,775 (against profit £3,253). Deduct tax reserve and other balances no longer required, £28,854, brought forward £11,018, and transferred from reserve £35,462, leaving credit of £26,559. Directors recommend dividend on first-preference for half-year to end December last, but no payment on second preference.

Stoneware (1928).—Trading profit for 1936, after charging all outgoings, including managing director's remuneration and providing for bad and doubtful debts, amounts to £85,208 (£32,655); add bank interest, interest on investments, transfer fees, etc., and £10,042 brought in, making £95,836. To directors' fees £1,075, to reserve for depreciation £7,000 (£5,500), to provision for tax £10,000 (£2,000). A final dividend on the ordinary shares at the rate of 5 per cent. per annum, and a special bonus at the rate of 10 per cent. per annum, absorbs £18,567, leaving £29,146 forward.

Canadian Industries.—Income for 1936, after providing for income and capital taxes, and making provision for depreciation and other contingencies, amounts to \$4,729,330 (\$4,299,140), equivalent to earnings of \$6.45 per share of common stock (\$5.85). Regular quarterly dividends were paid on the 7 per cent. cumulative preferred stock and dividends totalling \$6 per share (same) on common stock. After providing for dividends and retroactive increase in rates of taxation in respect of 1935, the balance of earned surplus at December 31, 1936, amounted to \$3,352,060 (\$3,149,420). The company is an associate of Imperial Chemical Industries, Ltd.

Salt Union.—The net profit for 1936 amounted to £206,370 (£219,905); add £13,392 brought forward and deduct debenture interest £42,000, leaving £177,762. A dividend of 9 per cent. is announced for the ordinary shares, absorbing £72,000; to staff superannuation fund £1,000, to contingencies account £20,000, forward £14,762.

United Glass Bottle Manufacturers.—A final dividend for 1936 of 6 per cent., less tax, against 5 per cent., plus a cash bonus of 2½ per cent., less tax, the same as in 1935, has been declared. The total 1936 distribution is thus 11 per cent., against 10 per cent. in 1935. Issued capital totals £1,218,377 in 601,355 7½ per cent. cumulative preference £1 shares and 617,022 ordinary £1 shares.

Pinchin, Johnson and Co.—A large advance in profits, record sales, and a 10 per cent. scrip bonus are the features of the preliminary statement for 1936. Net profits at £379,363 are up by £21,232. Tax takes £69,500, against £56,000. The final ordinary dividend of 12½ per cent., less tax, maintains the year's distribution at 20 per cent., less tax, and the carry-forward is £98,229, compared with £79,837.

New Companies Registered

Benn Industries, Ltd., 34 Walbrook, E.C.4.—Registered March 8. Nominal capital £100. Manufacturers of and dealers in chemicals and chemical goods, etc. Directors: Ben Z. Gittelson, and B. J. Franklin.

Metropolitan Asphalt Co., Ltd., 25 Fairfield Crescent, Edgware, Middlesex.—Registered February 26. Nominal capital, £1,000. Manufacturers of and dealers in asphalt, bitumen, tar macadam, stone, slag, etc. Directors: Samuel E. Lamming and Mrs. D. M. Lamming.

Leeds and Bradford Chemical Co., Ltd., Prospect Works, Farsley, near Leeds.—Registered March 6. Nominal capital £1,500. Importers and manufacturers of and dealers in chemical and industrial and other preparations, etc. Directors: Wm. Robinson, and K. Last.

Primrose Products (British), Ltd., Africa House, Kingsway, W.C.2.—Registered February 19. Nominal capital £1,200. To carry on the business of manufacturers of and dealers in chemicals (other than cream of tartar), drugs, medicines, patent medicines, etc. Directors: Oliver V. G. Hoare, H. F. Cabbell, S. Cresswell, H. N. Bream, H. S. C. Tyler, and C. Fazakas.

Redvales Chemical Co., Ltd., Spring Mill, Tottington, Bury, Lancs.—Registered February 18. Nominal capital £1,000. To acquire the business of chemical, colour and pigment manufacturer carried on by Cyril Duane as "Redvales Chemical Co." at Spring Mill, Tottington, Bury. Directors: Cyril Duane, and J. W. Crabtree.

Sulfurophosphate Manufacturing Co., Ltd.—Registered February 19. Nominal capital £1,000. To carry on the business formerly carried on by Sulfurophosphate, Ltd., and that of manufacturers of and dealers in fertilisers, manures, chemicals, etc. Subscribers: Keith A. Wyndham-Kaye, 37 Alexandra Road, Hemel Hempstead, Herts., and R. W. Horwood.

Wellson and Co., Ltd., Woolers Mills, Kirkstall Hill, Leeds.—Registered February 17. Nominal capital £1,000. To acquire the business of importers and exporters of raw materials used in connection with the manufacture of fertilisers, etc., carried on by Wellson & Co., Ltd., at 2 Woolers Mills, Kirkstall Hill, Leeds. Subscribers: Fredk. E. Knowles, and A. Knowles.

Books Received

Proceedings of the Chemical Engineering Group, Society of Chemical Industry. Vol. 18. 1936. Pp. 172. 21s.

Reports of the Progress of Applied Chemistry. Vol. 21. 1936. London: Society of Chemical Industry. Pp. 869.

Manchester Makes. A Survey of Lancashire Manufacturers Other than Cotton. Manchester: The Chamber of Commerce. Pp. 147. 3s. 6d.

The Dispensatory of the United States of America. Centennial (22nd) Edition. By H. C. Wood, C. H. LaWall, H. W. Youngken, A. Osol, I. Griffith, and L. Gershenfeld. Philadelphia and London: J. B. Lippincott Co. Pp. 1894. 65s.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Siam.—A firm in Bangkok desires to obtain the representation of United Kingdom manufacturers of tanning materials, stains, etc. (Ref. No. 852).

United States.—A firm in New York desires to obtain the representation of United Kingdom exporters of gums and essential oils. (Ref. No. 854.)

